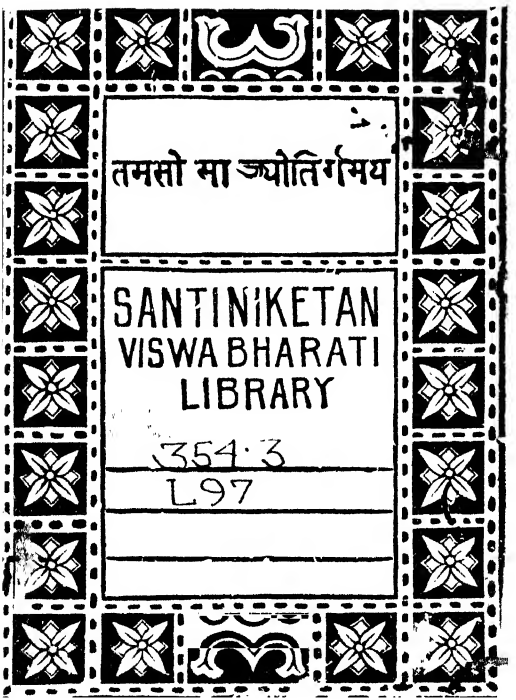
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HAPPY INDIA

HAPPY INDIA

AS IT MIGHT BE IF GUIDED BY MODERN SCIENCE

BY

ARNOLD LUPTON

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PREFACE

THE writer of this book having read about Indian famines and statements as to the generally half-starved condition of a large part of the Indian population, decided to visit that country in order to get some idea of its actual condition. He travelled from north to south and east to west. Furnished with introductions to the Governor-General and the three Presidency Governors, he had access to Indian Civil Servants and Indian gentlemen from whom he got information. Also he conversed with labouring agriculturalists and inspected some of their dwellings. He found a great mass of statistics in the publications of the Indian Government, and reports and books by men of eminence and of scientific attainments, and by Engineers, Agriculturalists, Economists, Medical Men, Professors and Teachers of great Indian experience. The India Office in Westminster and in Calcutta, and the Indian Trade Commissioner in the City and Indian gentlemen resident in London gave valuable information.

From what he has seen, heard and read, he finds that the men of knowledge confirm each other in their various statements, and he has been forced to the conclusion that India requires to be guided by men of science.

Under such a regime there would be abundance even for the poorest classes: granaries filled in good seasons would provide food for both men and cattle during seasons of drought. The poor labourer would have money for simple pleasures, and all classes might join in a prosperity that would make INDIA A HAPPY COUNTRY.

CONTENTS

HAPPY INDIA

CHAPTER I

Brief description of geography, climate, animals, population, history—Capacities and occupation of the people.

INDIA is perhaps the most wonderful country in the world, stretching from Cape Comorin on the south to the Karakoram range of mountains in the north of Kashmir, extending from 8 degrees to 37 degrees north latitude. It reaches from the high and desert lands of Baluchistan to the fertile uplands of the Shan States of Burmah, reaching from 61 degrees to 101 degrees east longitude. In round figures it stretches 2,500 miles from east to west, and 2,000 miles from north to south, bounded on the north by the snow-capped Himalayan mountains, the loftiest range in the world, and on the south it ends in the warm waters of the Indian Ocean.

No other continental country is so well protected from invasion on its land frontier. The Himalayas on the north, beginning at the extreme east and stretching through Kashmir to the Hindoo Koosh on the north-west, the Sulaiman mountains and

Kirthar range on the west. These, with the deserts of Tartary, Persia, Afghanistan and Baluchistan, constitute an almost impassable natural defence, and on the east mountains separate Burmah from China. A powerful military force in India could easily hold its own against any invader who came by land.

As regards climate, a traveller can in the winter find cold of great severity, if he goes into the northern mountains. In the summer time he can in Sind at Jacobobad and similar places find a temperature as hot, if not hotter, than any other place in the world. But the greater part of India is not subject to these great extremes of temperature, and on the Malabar coast on the south-west of the Peninsula the average monthly temperature in January, the coldest month, is only 6 degrees below the average monthly temperature of May, the hottest month. The average monthly temperature in January is 78 degrees, and in May is about 83 degrees, so that for purposes of warmth it is seldom necessary to wear clothes. As to Jacobobad on the west of the Indus, the average temperature in January is about 57 degrees and in June about 97, a difference of 40 degrees. Those are the average monthly temperatures, but the extremes, of course, are far greater—say from 30 degrees or less in January to 125 degrees in June, a difference of 95 degrees. There are also great differences in the rainfall. In Baluchistan, in Sind and Rajputana in some parts there are only 4 inches of rain in a year, some

years none at all in some districts, whereas at Bangalore in South-West India there is as much as 129 inches of rain in one year. In every part of India there is sufficient sunshine for raising the crops, in some cases for raising three crops in one year, and providing there is sufficient rain and the soil is fertile two crops can always be raised if the cultivator so desires.

The rain comes with the monsoons, and if the monsoons never failed, India would be a country where, so far as nature is concerned, life should be very easy. It is not necessary there to spend much labour in making clothes nor in building warm houses; it is only necessary to raise a little food to supply all one's animal needs.

India is a country which probably has been covered to a great extent with forests. Only a comparatively small area of forest land now remains because the trees have been cut down, partly to clear the land for agriculture and partly for use as timber and for firewood, for charcoal making, for iron smelting. Fires, either intentional or careless, have destroyed a great deal of forest.

India shares with other parts of Southern Asia and with Africa an astonishing variety of natural life. Elephants run wild, from 8 to 11 feet high, and rhinosceros; there are huge wild bulls 6 feet high at the shoulder, ferocious tigers and dangerous leopards, a great variety of harmless and of poisonous snakes, many kinds of deer and beautiful birds, also some disagreeable insects like mosquitoes which

are said to be carriers of disease, such as malaria; and beautiful fireflies.

But by far the most wonderful thing in India is its population of 319,000,000 people, varying in colour from white to black. In the extreme north-west the men are hardly distinguishable in size, features and complexion from Englishmen, and in the greater part of India the features of the people are similar to those of Europeans, but in some parts there are people of a different race or races. The people in the plains are darker in colour and in some parts of the south the complexion of some of the people is almost black. There are many different peoples and nations and languages in the vast territory called India, but when delegates to the Indian National Congress meet for a discussion of public affairs the language they use is English, and they can give the exact intonation and inflection of voice that an Englishman uses, although, of course, many of them do not speak exactly as an Englishman usually speaks.

India has a great history of which there are few records. Thousands of years ago India had great cities and great people. It was a great agricultural country, a great manufacturing country; it built fine ships which navigated the ocean—three hundred years ago Indian-built ships were larger, better and more durable than English-built ships; it had philosophers and statesmen, writers of great literature, and to-day its people either do or are capable of doing all the work that can be done

by any other people, and of taking a high place in all the arts and sciences, philosophy and statesmanship, of the world. Hundreds of years ago it was celebrated for its manufactures of cotton and silk. Indian muslins were much talked of. The Indians built great temples and grand palaces for their kings, and cultivated their soil with great skill and success. People in Europe heard of the great wealth of the Indians, and it was of the Indian cities they talked and the wealth of their princes and magnates.

Whether or not in those days there were poor poverty-stricken, starved people I do not know; probably there were. I have not seen records showing poverty more than three hundred years old, but books and poems are not written to celebrate poverty and starvation. A traveller in India to-day sees many signs of wealth—great cities and great shops, great manufactories, fields of corn and rice, many millions of well-to-do people, lots of fat men and women driving about in carriages. It is true he can also see men and women who are exceedingly thin and have no carriages in which to drive, whose clothing is exceedingly scanty and who look as if they have not sufficient food. But that applies to every country in the world.

The English came to India as traders hundreds of years ago, and parts of India were governed by English one hundred and fifty years since, and the greater part of British India came under British control one hundred years ago, being nominally

under the rule of the East India Company, but that Company had in many matters to submit to the British Government. It is only, however, since 1858, sixty-four years ago that India came under the direct control of the British Government.

The vast territory which now forms British India probably has never before been under one Government, certainly not in the last thousand years for any considerable length of time, but in previous years there were a number of Kings, and in considering the problems of Indian government we must bear in mind that it is not one people we have to consider with one set of ideas, but a variety of peoples with a variety of ideas on political and religious questions and various habits of life.

Whatever man can do, the Indian can do, whether it is agriculture, forestry, coal mining, gold mining, every other kind of mining, manufacturing, iron-working, fishing, hunting, sailing great ships or fighting in great armies, can be done, and has been done, by the people of India. But it must be borne in mind that a British workman working in Britain will do a great deal more work in a day than an Indian workman working in India; this is partly the result of inherited physical and mental strength, partly the result of climate and the difference in quality and quantity of food. Every art, every science, every branch of literature is familiar to them, and in dealing with the inhabitants of this enormous territory we must remember that we are dealing with people who are second to none in the

world. But still it must be borne in mind that their habits differ from ours to a great extent, perhaps in consequence of the climate. Whilst they can fight, they are not so desperately fond of fighting as the Northerners, neither are they so energetic as the Northerners, and the Briton coming fresh from his northern climate brings a degree of energy which is greater than that which is natural to the descendants of men who have lived for generations in the mild and warm climate of India.

It is not certain that the climate of India is the same now as it was two thousand years ago. The climate of Central Asia, Persia, Afghanistan and Baluchistan has changed—it has become warmer and drier: this is to be learnt from the writings of Elsworth Huntingdon in his books *The Pulse of Asia* and *The Transformation of Palestine*; and it may well be that the climate of Northern and North-Western India was more bracing in the days of Alexander than it is now.

There is one other respect in which the Northerners have an advantage over the people of the South—that is in fighting. In the case of a fight between two armies equally armed, equally well led and equal numbers, one British, the other Indian, the British would win, and would probably win though outnumbered two to one. Indeed, they have been frequently victorious against numbers five times as great as their own. On the other hand, the Indians have shown that with modern weapons and modern discipline they can win victories, and have

won victories in many a hard-fought field. It is, however, to be hoped that in the future the cruel, brutal, disastrous and foolish arbitrament of war will cease between nations that call themselves civilised. But it is not the object of this book to give the history of India or to describe the Government which there exists or to suggest a Government which ought to exist, but merely to give the views of an engineer travelling in that country who had no axe to grind and no object to serve except to do his best to gain a knowledge of essential facts and to express them in such a way that they might be of some interest to those people who wish to consider the welfare of those great peoples that own the sovereignty of the British King.

CHAPTER II

Reasons for a visit to India—William Digby—*Prosperous British India*—Some of the people half-starved—Good introductions—Centralised government—Discreditable to Government that there should be a great population insufficiently fed—Governor-Generals waste time and the resources of Empire in warlike expeditions—Better to raise the wages of the workmen—Extraordinary condition—Small British nation in control of enormous population of India—British Members of Parliament should visit India—British residents in India would be pleased—Moplah trouble—Caliphat—Landowners and tenants.

EVERYBODY, of course, likes to travel, and everybody who has not been to India would like to go there because of the extraordinary beauty of the scenery, the wonderful interest that attaches to the country and to the peoples, their ancient temples and to their more modern buildings and cities. Although the writer of this book confesses to the ordinary love of touring and seeing the world, yet his chief object in visiting India was in order to make some investigation into the condition of the people. Some twenty years ago he read a book by the late William Digby entitled *Prosperous British India*. This was a sarcastic title because the book is full of records of the poverty and misery of many millions of the people. And this poverty and this misery was not the opinion only of Mr. Digby, but his statements

were founded chiefly upon the reports of high Government officials, British officers, whose honesty and competence could not be questioned, and ACCORDING TO THESE REPORTS THERE ARE NOT LESS THAN FIFTY MILLIONS OF OUR FELLOW-SUBJECTS IN INDIA WHO NEVER EAT FROM BEGINNING TO END OF THE YEAR ONE GOOD AND SUFFICIENT MEAL. They have only one meal a day, and that meal is insufficient. This statement would be incredible if it was not vouched for by officers of high rank in the British Government who have no object to gain in exaggerating the poverty of the people under our rule, but quite the reverse: they would like to make a cheerful and hopeful picture of the life of the people who acknowledge the sovereignty of our King and obey the rule of our Viceroys and Ministers of State sent out from this country.

THIS BOOK STRUCK ME AS SO TERRIBLE AND SO HORRIBLE that I resolved that as soon as I had the opportunity I would go to India and try and ascertain from evidence on the spot what was the actual condition of the people. In November 1914 I landed in Rangoon, and after making a tour in Burmah, seeing Mandalay, Bhamo and Prome, I went to Calcutta and from there went up through the great cities of the Ganges Valley and the Punjab to Pesàhwar in the extreme north-west and then worked back through Gwalior and the centre of India to Hyderabad in the Nizam's territory to Madras, and then through Tanjore and Trichinopoly to Madura in the South of India, thence to Cananore

on the Malabar coast on the west, and thence through Bangalore in the State of Mysore to Poona and Bombay. I had introductions to the Governor-General and the Governors of Bengal, Madras and Bombay, and with the aid of these introductions I was able to get information from officers of high rank, both English and Indian.

I also bought a great many Government reports and statistics and other books, and came in contact with British instructors in agriculture, and British medical men (studying malaria), British engineers constructing works of all kinds. I also met Indian gentlemen and also some of the cultivators of the soil, and I verily believe that after my four months' tour I had collected more information about India as a whole than a resident in one locality would get in thirty years.

But in dealing with the great problems of the government of a country it is not so much what a man knows, but what opportunities he has for making use of his knowledge. Now every Government official knows that it is wise to observe the wishes of his superiors, and not to trouble them with suggestions which they do not want, and there is a tendency to centralisation in all Governments, and this is so in India. There is centralisation in each of the great Presidencies and there is further centralisation with regard to the Imperial Government of the Governor-General, so that we must not expect that an official will step outside of the course of conduct of ordinary official routine to

make radical suggestions, or, if made, to press them upon his superiors in office. It is the same with private residents, solicitors, barristers, engineers, doctors, manufacturers, planters, miners, merchants. They know that it is better for them if they do not interfere with the Government or make unwanted suggestions. They must not try to teach the Government how to govern. It is seldom that an engineer visits India without some business or professional object, or it may well be he thinks that some day he may wish to visit India again with some business or professional object, and therefore he will wisely be careful not to say or do anything when he is there or when he returns home which might possibly be disagreeable to the Government or any of his friends.

I do not propose in this book to deal with the great problems of autocratic, aristocratic or democratic government, with Indian Home Rule or Indian Independence, with Indian Councils and Indian Parliaments, as to whether India should be entirely independent and have no official connection with Great Britain, whether or not it should govern itself as one great country under one great Government of its own, or whether or not it should be a Union of States like the United States of America, or whether or not it should be as in former days, a country divided into entirely separate and independent States. All these are subjects to which I have not given sufficient serious study to entitle me to trouble other people with my opinions about them.

The subject which I have tried to study and on which I desire to write is the simple economic problem, India's wealth and India's poverty, India's health and India's diseases. I consider that it is disgraceful to the British Empire that there should be any large body of its citizens who are continually hungry. I do not think that the Government can be blamed for occasional famines. When the monsoon fails the crops fail, and there must be great hardship and shortage of food, and I do not say that occasional hardships are necessarily a great evil to a great people, but if I am told that fifty millions of the subjects of the Emperor of India never have a full meal from the 1st January to the 31st December, that when they have an occasional feast, as at the marriage of a daughter or a son, that feast is paid for with borrowed money, which leaves the father in debt for the rest of his life, then I think that something is wrong in the State, and that the first effort of any ruler should be to see if it is possible to improve the economic position of the people so that under average conditions of climate the people shall be well fed, well clothed and well housed, and live in sanitary conditions which give them the enjoyment of good health. These are the first conditions of national welfare.

If I were the Governor-General of India, I should not bother about Tibet or the Pamirs of the North-West, neither should I trouble the Ameer of Afghanistan nor feel the least bit anxious about Persia, but I should try first of all to see if the resources

of the British Empire would enable me to proclaim to the world that I had raised the economic condition of the people of India to one which might claim comparison with the other great peoples of the world. But the Governors of India have come from a class which knows no hardship, which has not got to consider the wages of the husbandmen or the amount of food necessary to keep a working man and his family in good health. Their minds for the most part run on military achievement, upon spectacular receptions and sporting expeditions. If, on the other hand, we were to send out a Governor-General from our own working classes or some engineer accustomed to deal with them, one of the first things he would enquire into would be the economic condition of the working classes, and he would naturally give his time and attention to considering how to ameliorate that condition where such amelioration was obviously necessary.

It is said that the Emperor Augustus boasted that he had found Rome a city of bricks and left it a city of marble, so a modern aristocratic Governor-General of India might boast that he found the new city of Delhi a city of ruins and that he left it a magnificent city of palaces. But the working-man Governor-General would be more likely to boast that when he went to India he found the wages of the poorest cultivator of the soil were about 4d. a day, and when he left he had raised those wages to 1s. a day, whilst the price of the necessities of life remained at the same level as when the wages

were lower. That indeed would be a glorious boast and one which I think is quite possible of fulfilment if the British nation would take any kindly and generous interest in the great Indian Empire.

Never before in the history of the world has a country containing three hundred and nineteen million civilised people with ancient and glorious histories going back thousands of years been subjected to the control of a nation of forty-seven millions living at a distance of seven thousand miles. It is obviously the solemn duty of the British nation to give its instant and serious attention to this great matter and to insist that the honour and glory and dignity of the British nation shall not be smudged because a certain Government department desires to be left alone in the government of our dependency.

I would suggest that as a beginning at least ten members of the House of Commons every year should visit India, dividing themselves into five separate parties, and should travel about to every district and see the resident Governors and Commissioners and talk to them about the affairs of their people. These Commissioners would be glad to know that members of the British Parliament were taking an interest in their work, and would give all the information in their power. They are for the most part good men, and wish to do good to all the people under their care. Think of the resident Commissioner in some rarely visited part of India who never sees any independent Englishman of

position to whom he can tell all his difficulties and all the difficulties of the people under his control, and to whom he can make suggestions, to whom he can point with pride to the good things that he has done, to whom he can mention with sorrow the good things that he has not been able to accomplish. This would be of great assistance and encouragement to him.

It is not absolutely necessary to limit the number of members of Parliament to ten, there might be twenty go every year, but they must not tour in India in large companies; two is sufficient or at most three, so that one interpreter can serve for the party, and the residents or other officials they interview can talk to them all at once. They can speak not merely to British officials, but to native officials and to the husbandmen in the fields, and the artificers and manufacturers of all kinds. They could visit the courts of law, the gaols and the hospitals.

But each year there should go a fresh party of members of Parliament, until the British Parliament has learnt something about India and has learnt to understand the vast responsibilities which Great Britain assumed when in the year 1858 it took from the East India Company the government of its great territory.

Whether or not the deposition of the East India Company from control was wise I will not say, but it is a matter of history that so long as the Company was in control, members of the British Parliament

frequently criticised its action, and espoused the cause of natives that they thought were badly treated. But when the Company was deposed and the British Government took entire control, how could that Government criticise itself and how could the obedient Parliamentary majority at home criticise the Government that it had put in office?

India must be visited not merely to see the sights and show-places, but to enquire into the condition of the poorest people. We have heard of the Moplahs rising in Malabar. Why should these people revolt? Possibly the feeling that the Caliphat is in danger may be one cause, but undoubtedly it is not the only cause, because these Mohammedan insurrectionists have attacked not simply the British, but chiefly the Hindoos. Now the Hindoos are in no way responsible for the British attack on the Sultan of Turkey, but they are the landowners and the Moplahs are to a great extent the cultivators of the soil, and they have suffered hardships. Possibly if their condition had been carefully investigated by independent observers, before feeling had got up to the fighting point, suitable relief might have been given and the sad revolt might have been prevented.

Sad because of the injury which the insurgents inflicted upon our fellow-subjects. It is also sad to think that so many brave men, good hardworking citizens (these Moplahs were all that) should be shot down by our troops when a little more care and kindness might have retained them as useful fellow-citizens.

The British members of Parliament travelling in India must not go to teach or to order; they must simply go to see and to ask questions. The right to ask questions is a great right, and the power that is exerted by asking questions is enormous. Though the traveller knows little, the man whom he asks for information knows a great deal, and when these travellers come with authority to ask questions, and when the man who knows is given a legal right and duty to answer those questions, then he can freely speak what he thinks without fear of rebuke from the central authority. He may speak wisely or foolishly as the case may be, but light would be thrown upon the subjects under discussion and the people would benefit, because these British travellers would have no axe to grind, would seek no appointment, no contract, no reward. They could not take contracts or rewards or appointments without losing their position as members of Parliament, which has cost them a great deal of time, money and energy.

CHAPTER III

Do the Indians of high caste interest themselves in the welfare of Indians of low caste?—What the British have done to benefit India—What they have failed to do—Desperate poverty of the cultivator and labourer—Contentment.

In considering the question of India, we must bear in mind that there is a great difference between an English gentleman of high position and a Hindoo gentleman of high position. The Britisher can associate with men and women of every rank. He will neither contaminate nor be contaminated by association with any other man or woman, but the Hindoo gentleman who associates with people of inferior rank must be careful lest he loses his caste, and is apt to take but little interest in people of lower class than himself. In talking with Indian gentlemen it is interesting to observe that they do not seem much to have considered the economic problems of the working class, the question of feeding the poorer cultivators of the soil. These are matters to which they have not given much attention. They quite realise that they themselves are equal in intelligence to the Englishman, that they know as much as he knows and perhaps a great deal more, and they do not see

why they should be governed by men who are in no way superior to themselves, and therefore they quite rightly and quite naturally seek independence, but they have yet to show that they consider the conditions of the poor Indian cultivator as much, or more, than the British resident Commissioner in India.

No doubt these rules of caste are being modified, and will be rapidly modified as the Indian gentleman perceives the necessity of associating with his fellow-subjects of all ranks, and whatever may have been the ground, whatever the need, whatever the advantage of the caste regulations in the past, he must see that now it is impossible to trust the government of India to a class who will not associate with the most useful class in the country; that is to say, the poor labourers and the poor cultivators of the soil.

When the cultivators of the soil in India have a sufficient income to live as good working men ought to live, then all classes, all artificers, all factory workers and miners, will also have a sufficiency. It is also necessary that the British Government should at once investigate the problem of the economic condition of the Indian peasants and proceed without delay to secure the necessary amelioration.

If the British Governor-General was asked what the British had done for the good of India, he would point to great high roads improving communications, he would point to railways, irrigation canals, the great harbours and cities of Calcutta, Bombay and

Karachi, he would speak of the Peace which we maintain in India, and compare the condition now with that when Northern India was fighting with Central India and Central India was fighting with Southern India, and he would show that in the time before the British made the railways, when the monsoons failed in one part of India it was impossible to convey to that part the superabundance of the crops in another part, whereas now with the aid of our railways we could always supply the parts where the monsoon had failed with sufficient food to keep the people alive. He would say that in ordinary years the people of India produced more corn than they could consume, which they exported to European countries, and with the price they got for that were able to import articles of great value, but that when there was a famine year the export of corn was stopped and the surplus of the district where there had been plenty of rainfall was diverted to the district that was short of food, and thus we have mitigated the terrible destruction of life and ruin of the people to which they were subject in times of famine in former days. And in all these statements he would be telling the simple truth.

On the other hand, the critic would observe that it was unfortunate that after the people, the cultivators of the soil, had had many years of favourable monsoons when there was plenty of rain, they had not been able to save sufficient money to enable them to buy food supplies from other parts of India

when their monsoons had failed, and that at the first sign of approaching famine it was necessary for the Central Government to come to their relief, and supply them without charge with the necessary food. He would also observe that the railways and improved seaports had led to the export of corn, which in previous times had been stored by the thrifty peasant in anticipation of possible droughts. He might say that it was a pity that even in the years when the rainfall did not fail some of the people had not enough to live upon, whilst in other parts of India large supplies of corn were exported to Great Britain. Thus one part of our Empire might be starving and another part have a super-abundance of food. There have been many famines in India, but all the famines, though covering in reality a very large area of territory, have been, as compared to the whole of India, only local, and there has always been a sufficiency of food in India to supply all the people with what was necessary for their health and subsistence. Starvation has arisen firstly because of the poverty of the peasant in the district where the rainfall had failed, so that he could not afford to buy the necessary food; secondly, the difficulties of transport from the district where there was a superfluity to the district which was in need of outside supplies. This transport difficulty has to a great extent been cured by our railways, though no doubt further railways would be a great advantage, and if it was not for the poverty of the peasants preventing them from buying the

supplies they need we should seldom hear of famines in India. But as things are it is necessary for the Government to come to the aid of the people as soon as there is a failure in the rainfall and to supply them with food, and probably to establish works where the men can labour in return for the food that is given to them. This, of course, is very unsatisfactory, but it is the only way in which the people can be saved from death when the rainfall fails. But notwithstanding the railways and Government aid in the year 1918 the death-rate for all India rose to 62 per thousand of the population.

There is also the question of their cattle. When there is little food for human beings there is generally little food for the cattle and it is difficult to afford food for their support, and what is the condition of the peasant when his cattle are dead? He has no ox to drive his plough or cart and therefore it is a pity that greater stocks of food are not maintained in all districts in view of the possibility of famine, and also that the people should not be able to save sufficient money to enable them to buy from others the necessary supplies for themselves and their cattle.

It is, of course, easy to make these criticisms, but how is the present state of affairs to be remedied? Before we can suggest a remedy we must know the cause. Why is it that over such large areas the cultivators of the soil are in such a condition of desperate poverty? What causes lead to this? When did this poverty first begin? Has it always been so in India? Or is it of modern growth?

In considering the question of famine and food shortage in India, we must bear in mind that most countries which depend on their harvests for their food are liable to food shortage and famine. It is only in recent times that England has escaped from famines. Eighty years ago England depended on its corn crop to a great extent, and if the harvest was deficient poor people died by thousands. It is only since Free Trade was established in 1850 that by means of our coal exports, and exports of manufactured goods, we have been able to claim food supplies from any part of the world that had a surplus, and in that way, and in that way only, have escaped from periodical famines.

It is quite easy to see why the Indian peasant is now excessively poor in most parts of India. It is simply this: the condition of the soil is too poor, it does not yield enough; it does not yield one-half of what the British soil yields. What would be the condition of the British farmer and the British labourer if for all their labour they only got one-half of their present produce per acre? Yet the Indian labourer works very hard, and he and his family give minute and particular care, working often from morn till dark, and yet the produce per acre is not more than one-half of the British produce per acre. When one considers that out of this half he has to pay rent, he has to pay a salt tax and some other taxes, it is not surprising that his economic condition is extremely bad: the only wonder is that he can exist at all; and he exists simply

because he has learnt to live in an exceedingly cheap manner.

His mansion is a mud hut with a roof of sticks and palm-leaves ; his bedstead, if he has one, consists of twisted sticks which raise his mattress, if he has one, six inches from the ground. He has no door or windows to his hut. He has a little fireplace and cooking place outside. The sofa upon which he can recline in leisure moments is made of mud outside his sleeping chamber. He has one garment round his loins and he has no other garment that he can wear whilst he is washing that one garment. He neither smokes nor drinks nor reads the newspaper ; he goes to no entertainments. His religion teaches him humility and contentment, and so he lives contentedly until starvation lays him on his back.

CHAPTER IV

Agricultural statistics—90 per cent. of the labouring producers engaged in agriculture—72 per cent. of the population engaged in agriculture—Small production of grain per acre—William Digby says in the year 1899–1900 the average income of the working classes equalled a halfpenny a day for each man, woman and child—In years of scarcity numbers die—Digby blames Government—Mismanagement—Excessive taxes—Drain of £30,000,000 to Britain—An engineer finds it difficult to accept this view without qualifications.

WHATEVER may be the sins of the Indian Government, at any rate this can be said in its favour, that it has produced and does produce regularly a great mass of statistics dealing with agriculture. These statistics give the acreage of every crop and the production in pounds per acre of every crop; they give the value of each crop produced. They also give the numbers of cattle of all kinds, cows, bulls, buffaloes, horses, camels, sheep, goats. (But pigs and poultry are not given.) On the assumption that these statistics on the average are fairly accurate, it is possible to arrive at a fair estimate of the productions of India. And in addition to the produce of the fields, the produce of the mines are given in some detail. The statistics also give the price of every production of the fields and of the mines, goods of various kinds, both wholesale and retail. The wages

of labour of every kind are given; statistics of imports and exports, the work on the railways and on canals; in fact, a diligent search of the books published by the Indian Government will give an enquirer a tremendous mass of information about our Indian fellow-subjects. So that if we are in ignorance about their material condition, it is simply because we do not take the trouble to enquire.

The foremost and most important fact about the Indian people is this: out of every hundred, seventy-two are engaged in agriculture, and Indian importations of food are negligible as a general rule. It is therefore a matter of vital importance that their work should be very productive, that they should obtain a great amount of corn from the ground which they cultivate, because it is the produce of the soil which has to feed all the people, not only those who work in the fields, but those engaged in mines, manufactures, building professions, army, police, domestic service, etc., transport by sea and land, in the Government of the country. All the cities, docks, canals, railways, roads, armies, police, professional classes, all have to be maintained chiefly by the production of the soil.

So now the important question is, What is the production of the soil? We will take for the purpose of consideration the production of wheat and consider how many pounds of wheat are produced per acre. For the purpose of comparison, we will first take the production per acre of wheat in England. The

average at the present time is about 2,000 lb. weight of grain per acre. It varies from much less, say half that, 1,000 lb. per acre, up to much more, 4,000 lb. per acre. Both these are extremes, and the ordinary production is somewhere near the average above given. Now, in India the average production of wheat (*Statistics of India*, 1921 [No. 1344]) in the whole of British India, including irrigated and unirrigated land, average of eight years ending 1920, was 690 lb. of grain per acre, or rather more than one-third of the average British production.

The wheat crop of India is the second most important crop, and about ten million tons of wheat are produced in a year. Over a great part of India the climate is in an average year favourable to a wheat crop. The Indian agriculturalist is a clever, capable, hardworking man, so that in the average year he ought to produce a large crop; it certainly ought to be equal to the English crop. Now, in England the people do not depend upon their wheat crop for their wealth, the chief wealth is produced from their mines and manufactures; and whether they have a good corn harvest or a bad harvest, they can still get along very well. A bad harvest of wheat in England is generally the result of too much rain, but this rain is good for grass and roots, so the cattle have plenty. But a bad harvest in India comes from want of rain, and not only the corn crops, but grass and every other crop fails. It means ruin and starvation, and yet every year in India as regards the wheat crop they have what the British farmer

would consider a shocking bad harvest. It is therefore easy to understand why there is poverty in India.

We will now consider another crop, the principal crop, that is rice. Now, the average rice crop (No. 1344) for the eight years ending 1920 was 885 lb. per acre, much less than half the average of the British wheat crop. Other crops are for the eight years ending 1920 (No. 1344) approximately as follows: barley 840 lb. per acre, then various millets, jawar 500 lb., bajra 370 lb., maize 880 lb., gram 605 lb. Taking into account the acreage and tonnage of each of the above-named seven crops, we find that the average crop of grain for the whole of India in the year 1919-20 (No. 1344) was about 620 lb. per acre, and that year was about 10 per cent. better than the average of the eight years ending 1920, that is including the rice crop and the irrigated land. Thus the average of all the crops in a fairly good year is less than one-third the average British wheat crop. It is therefore evident that unless the average crop can be much improved, India must always remain a very poor country.

It may be said that while the yield of grain per acre in India is very low in comparison with yields in England and Germany, it is not so low when compared with the yields per acre in parts of other countries such as America and Australia.

The reply to that is that in those very thinly populated parts no manure is used, and also that

the amount of human labour employed is small, and that the production per man employed is very large—ten times as much as in India.

One of the questions that occur is, Has the crop always been as small as it is now? And if it used to be a better crop, why has it gone down? The second question is, Is it possible now to improve the Indian crop? Can it be doubled and brought up to the British average? Some people think it can, and if that were done India would become a rich and prosperous country.

I have not been able to get an answer to the question, Was the crop per acre larger in former days than now?

When the population was only half or two-thirds its present number, only the better land need be cropped; there would be plenty of room for fodder crops and grass for the cattle. There would be plantations from which wood could be got for fuel, so that all the cattle dung could be used for manure instead of burning it for fuel as is now done. Undoubtedly the Mogul Emperors got a bigger revenue per acre cropped than the present Government gets. These are reasons for suggesting that the yield per acre cropped was greater two hundred years ago than now. But learned and competent men who have studied this question find no evidence to support the suggestion.

But some answer must be given to the question. The Mogul Emperors got a bigger cash land revenue from a smaller area, and the rupee would buy five

times as much rice or wheat in their time as it buys now. How did the Moguls get a bigger land revenue if the crops per acre were no bigger than now?

I will suggest possible answers.

(*a*) If the population was less dense and each farmer had three times the area to cultivate that he now has, and if he had strong well-fed oxen to plough and carry, each man might produce three times the amount of grain that he now produces, and so he could pay half the crop to the tax-collector, instead of only one-tenth part of the crop as now, and so the revenue per acre might be five times the present revenue.

(*b*) The Mogul conquerors, perhaps, did not recognise any person as a landowner except themselves. So that there might be no intermediaries to collect rent and live on it, paying only a small fraction of this rent to the Government.

I think it probable, though I have no sufficient evidence to do more than suggest probabilities,

(1) That the crop *per acre* was larger two hundred years ago than now.

(2) That the production *per man* was in a much larger proportion than now.

(3) That landowners were not recognised, and that the tax-collectors had to work hard for their living.

PROSPEROUS BRITISH INDIA.

BY WILLIAM DIGBY.

Any person wishing to understand the economic condition of the Indian people should read a book published in 1901, written by William Digby, and entitled *Prosperous British India.* This is a sarcastic title. The chief objects of the book are two, one is to show the extreme poverty of the great mass of the Indian people, the other is to show that this extreme poverty is probably due to the exceeding bad government of the English. He thinks that the English mean well, wish to govern India in the best possible manner, but are too ignorant and too proud to accept the advice and guidance of the Indians themselves, who know a great deal more about their country than it is possible for an ordinary Englishman to know. I have read the book twice with great care. It is, however, the saddest book that it is possible for any man to read about our great Empire, with its three hundred and nineteen million people, the greater part of them living in a poverty so extreme as to be almost beyond the conception of a modern Englishman.

According to Mr. Digby, the average income of the working classes in India was in the year 1899–1900 equal to one halfpenny a day for each man, woman and child, so that with a family of four there would be twopence a day to keep the lot. In the year 1899 the prices of food were much less than

they are at the present time, because then the cornfields of the United States had a surplus of corn to send to Europe, and the cornfields of Canada had not been so much developed, the cornfields of Russia had a surplus which they sent to the rest of Europe, also the population of India was less, and these things depressed prices; but at the prices ruling then, the small earnings of the Indian peasant did not enable him as a rule to buy sufficient food for health and strength. He could hardly afford to buy any clothing, and for the most part he lived and lives in mud huts, with a very rough kind of thatching to keep out the rain. There has not been known to any Englishman such a condition of poverty since the early forties of the nineteenth century, when the agitation for the repeal of the British corn laws was at its height, which led ultimately to the Act repealing the duty on imported corn in 1846, which took full effect in the year 1850. But the British pauper is far better fed than the average Indian peasant. He is not only better fed, but better housed and better clothed. This extreme poverty of the Indian peasant is not the result of a failure of the rain, not the result of a famine due to failure of the crops, but is the ordinary condition of a large proportion of the Indian peasants. When there is a famine, great numbers of them die.

Mr. Digby entirely disproves the accuracy of the optimistic statements of some Secretaries of State and Governor-Generals and of some of the figures given in some Government books of agricultural

statistics as to the amount of corn raised per acre. He gives case after case showing that the amounts really raised are much smaller than the Government estimate; on the other hand he quotes some of the official statistics with approval.

Mismanagement and Excessive Revenue Charges.

Mr. Digby attributes the poverty of the Indian people in a great measure to simple mismanagement by the British officials, resulting from their ignorance of the country. He also attributes it to excessive exactions for revenue, and to want of elasticity in the collection of revenue, having regard to the condition of the crops, failure to make an allowance to the farmer when the crop is a bad one, therefore forcing the farmer into the arms of the money-lender, who ruins him with his charges for excessive interest. He also considers that our Government is very expensive, because of the large salaries it is necessary to pay to Englishmen to induce them to live in India, whereas the work could be done, he thinks, much better by Indians, who would be glad to take much smaller salaries than the Englishmen have. Also excessive charges for the army and expensive wars, such as the Afghan wars. He also considers that the charges made upon Indian revenue for pensions to Indian civil servants and military men retired, and for interest on the cost of building railways, constitutes a drain upon the Indian people which they cannot afford to pay.

Indian gentlemen who wish to bring about reform agree with Mr. Digby in this respect, and consider that the money payments made to England for pensions for civil and military services and for interest on capital advanced, amounting in all to something like £30,000,000 a year, is a drain which India cannot afford, and is one of the chief causes of the poverty of the Indian people. They, Mr. Digby and those Indian gentlemen who sympathise with his views, do not admit that India derives any corresponding benefit for the money which they pay to England for the pensions above mentioned or for interest on the railways. I gather they do not admit that the railways have been any benefit to them. I know that some of them think the railways have been an injury. It is, of course, difficult for an English engineer like myself to admit such a statement as that. One would think that railways could not fail to be a benefit, reducing the cost of transport, but the Indian says that this facility of transport has caused the Indian farmer to send his surplus corn to some seaport to get exported to Europe, whereas before railways came he put it into a granary, and had it to live upon when there was a failure of the crops. To this, of course, the British railway engineer would reply that he has no objection to their building granaries in which to store their corn if it will keep for any length of time, and, of course, the true answer is that the Indians would not export their corn more than was prudent, unless their poverty compelled them.

The storage of grain enough to keep fifty millions of people in good health for two years, allowing something also for the cattle, is a matter requiring great consideration. The value of the grain at £2 per head per annum would be £200,000,000. For a family of five persons there should be 3,000 lb. for a year, or 6,000 lb. for two years; this would supply them with all the grain they require without any addition, but would leave nothing for cattle. I should be surprised to learn that there are granaries in the country now, in any area containing fifty million people, able to contain half this quantity of grain. But in a country like India, where droughts and famines are so frequent and so deadly, great stores of corn ought to be kept. The Indian cultivators know how to preserve their small stores of grain, and it would be a good thing if each cultivator had his own store that would last a whole year. In great granaries special means have to be adopted to keep the grain in good condition, which involve great outlay of capital and considerable annual expense.

CHAPTER V

Criticisms useless, unless remedies suggested—In India dung of cattle used as fuel, not as manure—Soil impoverished, wheat crops of 400 lb. per acre—Is produce fairly divided between cultivator, landowner, money-lender, revenue?—The cultivators have no other fuel, there being no wood—Gujarat exception—Plantations for firewood required—Himalayan forests could supply wood, collieries could supply coal—British honour involved.

IT is useless to criticise the British Government of India unless one has a remedy to suggest for the evils of which one complains. Now, the chief evil of which one complains is the excessive poverty of the agricultural population, including the tenant farmers and the labourers who have no land.

This poverty is due in the first instance to the small return that the soil gives for the labour which is put on to it, and, secondly, in many cases to the way in which the produce of the soil is divided between the landowner and the cultivator. The amount taken by the revenue authorities is on the average and on the whole very moderate, but the tenant cultivator over a very great part of India has to pay a rent to the landowner, or to pay interest to a money-lender, so that he does not get what he produces. Thus there are two remedies for the

conditions of the poor cultivator who has land and the poor labourer who has no land: one is to make a more fair division of the products of the soil, and the other, and by far the most important remedy, is to increase the products of the soil, care being taken that the increased product of the soil does not go to some rent-receiver or money-lender, so as to cheat both the cultivator and the revenue.

Every person who visits the agricultural districts of India and sees the fields and the houses of the cultivators, and who takes any interest or has any thought about the products of the soil, is at once struck by this most important and most monstrous fact, that a very large part of the manure that should go into the soil to increase its productiveness is used as a fuel for warming the dwellings and for cooking the food and other purposes. The cow dung is picked up and plastered in cakes on the walls of the houses so that it may dry in the sun. Sometimes it is kept for the use of the householder, sometimes it is sold to the town for the use of people there. If a visitor remarks upon this fact, he is told: "Oh! it cannot be helped, there is no other fuel that these poor people can afford to buy; there is no wood, and they cannot afford to pay for coal, and therefore they must use this manure for the purposes of fuel."

So that from east to west and from north to south, with the exception of Burmah, this use of a very valuable manure is the general practice in British India. The mere fact that this is done is sufficient

to condemn the Government of India. It is the most horribly ruinous, unprofitable, uneconomical, and wicked thing it is possible to do, and yet the Government never stirs a finger to prevent this from being done. It may be said, "Why blame the Government? Surely the people can take care of themselves." That might be, but there is a Government, a Government which interferes and regulates, has policemen and magistrates, and prisons and soldiers, which maintains the present order of things, which knows that the present order is wrong, but which allows this wrongdoing to continue.

It is many years since Englishmen of scientific attainments, chemists, agriculturalists employed by the Government to advise, and other officials high in office, have pointed out that this burning of the manure as fuel was wrong and ruinous, but the ordinary answer is, "Oh! it cannot be helped, there is no other supply of fuel for the poor people." Yet this wicked thing is not done everywhere. It is not done in Gujarat. In that province there are plantations from which fuel can be cut for the use of the inhabitants, and which also provide shelter and food for the cattle.

What can be done in Gujarat can be done all over the rest of India. The Government of India can spend money when it likes, it can send an army to Tibet and a great army to Afghanistan, it can maintain armies fighting in the north-west; but when it comes to fighting the poverty of the people the Governor-General and the other Governors and

other great officials seem to take but little interest. It is high time they were stirred up and told that if they wish to work for their own honour and the honour of their country, the honour of the British Government and the honour of the British Empire, the honour of the British people, they will set to work without delay to remedy this great and glaring evil.

The remedy could be so quickly made. In India, in those parts which are irrigated, it does not take long for a plantation to grow sufficiently high to supply firewood. In a couple of years a village would have a plantation which would provide more firewood than all the cowdung which they now burn. Of course it requires a little arrangement and a little management, but what is the Government for if it cannot do those little arrangements? It might be necessary in some districts where there are wealthy landowners to put a little tax on the landowner, or some portion of the rent he gets might go to the construction of these plantations to supply fuel for the people. It is not a question that admits of any doubt, every agriculturalist of science, every agricultural chemist would give the same answer, and he would say that every crop which was taken from the soil takes away from the soil substances which are necessary for the following crops, and the only way to maintain the fertility of the soil is to restore to it as much as possible those substances which are taken away from it. A great part of those things are contained in the dung of the

cattle, cows, bulls and buffaloes, sheep, goats, horses, donkeys, mules, camels. This dung contains phosphates, potash and nitrates, humus, and other things of great value, and without these things the soil cannot give a good return for cultivation.

Therefore we have the extraordinary fact that in India the wheat crop is frequently only one-fifth of the average wheat crop in Great Britain. A crop in India is often only 400 lb. of grain per acre, as compared with the average British crop of 2,000 lb. of grain per acre. There are mighty forests in the Himalayas, and in other parts, from which small wood might be cut without destroying the forests, and which might be sent in trucks over a great part of India to supply the needs of the people. Coal might also be sent to the towns, instead of the towns buying cowdung from the agriculturalists. Of course the necessary arrangements mean a lot of bother, but if the Government is going to govern at all it had better try to govern well. One would like to feel proud of one's nation, and it is to be hoped that the nation will stir itself and put things right in India without delay.

CHAPTER VI

Mercator's projection misleading for landsmen—Enormous area of India—Forest area, possibility of forest supplies of fuel—Enormous profit resulting—Railway and motor lorry conveyance—Government has no capital, must borrow to make roads and railways necessary for full use of forests—Coal supplies possible—Weight of cowdung burnt and of wood or coal required as substitute—Growth of timber in plantations—Enormous profits from resulting increase of crops—Reafforestation Etawah district of United Provinces—Some statistics of forests—Table I.

ANY person reading that the Indian cultivators were forced to burn cowdung for fuel because there was no wood or other combustible at hand would imagine that India was short of timber and short of coal. That, however, would be a very great mistake. India has abundance of timber and abundance of coal. It is only because of the extreme poverty of the cultivators and the indifference of the Government that there is any shortage of fuel, either wood or coal, in the huts of the people. In considering India we have constantly to bear in mind the enormous area of the country, and we are continually misled by the horrible maps which are so popular on Mercator's projection. Looking at one of those maps, one imagines India to be a small country, and Siberia to be an enormous

country in comparison, and England shows up very much larger in proportion to India than it really is. Maps on Mercator's projection ought to be abolished from ordinary use because they are so misleading. On Mercator's projection all the lines of longitude are drawn parallel, whereas everybody who has ever looked at a globe knows that they converge towards the Poles, and all meet at a point at the Arctic and Antarctic Poles. A line of latitude drawn through Calcutta is about 23 degrees north latitude, and a line of latitude drawn through the centre of the British Isles is about 53 degrees north latitude, and the lines of longitude converge to a point at 90 degrees north latitude, and therefore on a map on Mercator's projection England appears nearly twice as wide from east to west in proportion to India as it really is.

Now, the area of India is, roughly speaking, about forty times the size of England and Wales, the population is nearly ten times as great as the population of England and Wales. The area of India in acres is 1,152,000,000 acres, and excluding the Native States, the area is about 700,000,000 acres. Including the Native States, there are 100,000,000 acres of forests, and excluding those States, there are about 88,000,000 acres of forests under Government control. There is in addition a large area of forests which is not under Government control. When we consider that the entire area of England and Wales is about 47,000,000 acres, and that the area of controlled forests in India is nearly

twice as great, we begin to realise the enormous extent of the Indian forests. These forests could supply 100,000,000 tons of wood every year, wood suitable for fuel, without in any way damaging them or reducing the production of timber suitable for building and timber work of all kinds.

But these forests are not easily available for the supply of wood fuel because they are in the mountains, and it would be necessary to make a good many new railways into these forests in order to get at the timber, and it would involve a considerable outlay of capital, and the Indian Government has no capital, it could only get the money by borrowing. It would have no difficulty in borrowing, only it would have to raise the money to pay the interest on the loan by means of taxation, and people do not like paying taxes, and therefore the Government does not like to make itself disagreeable in that way more than can be helped. There are extensive forests in the Independent State of Nepal, and, if necessary, it is quite possible that permission might be got to buy timber from that country. Whilst the most important forests are in the mountains of the Himalayas, in Burmah, and on the Western Ghats, still there are forests scattered over a great part of India, so that if railway conveyance was properly organised, supplemented by motor lorry conveyance, or traction by oxen, it would be quite possible to supply every district with wood fuel from existing forests without doing any damage to

those forests, or lessening their usefulness, or injuring their permanence.

Over the greater part of India it would be difficult to find a cultivated area more than one hundred miles from a forest capable of supplying firewood. To this, however, the exception must be made to some parts of the United Provinces of Agra and Oudh, some parts of the Punjab, and parts of Rajputana, Sind, and Baluchistan. It is, of course, impossible for a poor cultivator to take a waggon a hundred miles to fetch firewood for a year, so it is necessary that the conveyance of this firewood should be either by railway or motor lorry, which might deliver the timber to some place from which it could be conveniently fetched by the cultivators. Of course a motor lorry cannot work except upon a good road, and the construction of that might involve great expense—indeed the expense might be greater than that of making a railway.

But this expense would be amply repaid if there was an increase of the crops of, say, 20 per cent., because these crops, according to the prices of the year 1919, are worth £1,000,000,000 (and much more), and an increase of 20 per cent. would therefore be worth £200,000,000. Now, a light railway might be made at a cost of something like £5,000 a mile, that is about 200 miles for £1,000,000, or 20,000 miles for £100,000,000; that is to say, the outlay might be repaid twice over in one year, if the result was to increase the crops 20 per cent. But if the increase in crops was only 5 per cent., that would

pay 50 per cent. on the cost of these railways, looking at the matter entirely as a national outlay and national benefit. The cost of carrying 40,000,000 tons an average distance of 60 miles by railway would be about £10,000,000.

There is, of course, another way of providing the fuel, and that is to supply coal to all the villages. There is plenty of coal in India, and a demand for another 20,000,000 tons a year could be fully met in the course of five years, and in every village where there is not a sufficient supply of wood fuel coal might be sent, so that there should be no excuse for continuing the present practice of burning manure. Doubtless it would cost a great deal to convey the coal to some places a long distance from the mine, but even this great cost would be better than burning up the manure. Coal might be conveyed by railway 1,000 miles at a cost of £1 a ton, and if the price of the coal was 10s. at the pit, that would make the cost 30s. a ton at the end of the railway journey, so it might be said that the consumer would get the coal at a cost of 35s. a ton. But the average journey would probably be only about 300 miles, and the cost of conveyance by train, say, 10s. a ton, so that coal might reach the consumer at a cost of 25s. a ton, and one ton of coal would be as good as two tons of wood.

But whether the fuel be supplied by means of wood brought from long distances by new railways, or by coal brought from long distances, also requiring new railways, it would be a long time before all

these new railways were made and the new coalmines developed, and it might easily be asked, Is there no quicker and cheaper mode of providing the cultivator with his small wants in the shape of fuel? What is the quantity that is required? If we assume that on the average the cattle, including cows, bulls, buffaloes, horses, mules, donkeys, pigs, sheep, and goats, are equivalent to as much as one ox per head of the agricultural population, and assuming that one ox will give 1¾ tons of dry manure in a year, then for a family of five we have rather more than eight tons of dry manure from the domestic animals; and if one-half of that is burnt, we have rather more than four tons of dry manure that is burnt. If we assume that dry wood is twice as good as dry cowdung for fuel, then if we supply the cultivator with two tons of dry wood, he will have sufficient fuel to enable him to put all the cowdung into the ground; and if we assume that one ton of coal equals two tons of wood, then one ton of coal would be sufficient for the average cultivator's household for one year. The population engaged in agriculture is about 170,000,000 in that part of India which is under direct British government, and taking the householders as being five persons, there are 34,000,000 households which, on the average, require one ton of coal per annum. Some of these, of course, require none, some want two or three tons of coal a year, and some want only half a ton of coal a year, and there are many persons in the town who now buy cowdung as fuel and who would have to be supplied

with other fuel if the cowdung was used as manure. Therefore we may take it that about 34,000,000 tons of coal are required in addition to the present output of coal to supply the needs of the country, or, on the assumption that one ton of coal is equal to two tons of wood, 68,000,000 tons of wood per annum are required to supply the needs of the country in addition to the present supply.

It must, however, be borne in mind that India is not the only country in the world which relies on wood as its chief fuel, especially in the country districts. If one travels in France and Germany, Austria, Switzerland, and the Tyrol, one sees everywhere plantations of trees or large forests, as the case may be, from which the people of every town and village can get supplies of wood. The fuel question has been settled there by the Governments of those countries, which took care that the country was not entirely disforested, or where it had been disforested that it should be re-afforested, so that there should be sufficient wood in every district. But in India, with its larger districts, distances tend to be much greater than in France and Germany. Still, if one looks through the list of the forests in the various provinces of India, one finds that there are very few districts where there is not some forest land, and by that I mean forest land which is maintained by the Government as forest land, because there are enormous areas of so-called forest land which are not maintained by the Government, and upon which reliance cannot be placed.

I have prepared a table giving the names of the chief divisions of India and the number of districts in each division which possesses forests, which are large, or considerable, or insignificant, or where there are no forests, and also the percentage of forest land to the total area and to the area under crops (see Table I, p. 62).

The total area of India under direct British rule, as given in *Agricultural Statistics*, 1919–20, is 625 million acres, as given in *Financial Statistics* for the year 1918–19 (published 1920) is 692 million acres.

In *Financial Statistics* the following figures are given :—

British India, including native states, total area in square miles		1,080,794
Forest area in square miles—		
Reserved	101,639	
Protected	8,557	
" Unclassed State " includes many areas of waste devoid of trees	141,272	
Total	251,468	

Proportion of forest area to total area of British India, about " 23 " per cent.

The combined reserved and protected areas, 110,000 square miles, equal to about 70,000,000 acres, and the 251,000 square miles, equal to about 161,000,000 acres, should be compared with the 88,000,000 acres given in *Agricultural Statistics*, and the proportion of forest area given as " 23 " per cent., must be compared with the 14 per cent. given in *Agricultural Statistics*.

The *Imperial Gazetteer of India*, published under the authority of the Secretary of State in 1909,

TABLE I.

Indian Forests under Direct British Control.

Name of Province.	Total Area of Forest in Acres, approximate.	Total Districts in Province.	Districts with considerable or Large Forests.	Districts with insignificant Forests.	Districts with no Forests.	Percentage of Total Forests to Total Area of Province, approximate.	Percentage of Total Forests to Total Area of Province under Crops, approximate.
Bengal	4,275,000	27	6	1	20	8	17
Madras	12,970,000	26	23	1	2	15	36
Bombay	8,553,000	19	14	3	2	18	30
Sind	800,000	7	3	4	—	2½	19
Agra	8,700,000	36	11	4	21	16	32
Oudh	613,000	12	3	—	9	4	7
Bihar and Orissa	7,400,000	21	9	1	11	14	29
Punjab	2,300,000	28	13	11	4	2½	7
Upper Burmah	13,300,000	19	17	—	2	24	250
Lower Burmah	7,500,000	21	16	2	3	13	79
Central Provinces	14,600,000	18	18	—	—	27	84
Berar	2,137,000	4	4	—	—	18	34
Assam	3,500,000	13	11	1	1	10	59
North-West Frontier	363,000	7	3	1	3	4	17
Agmer Merwara	96,782	3	2	—	1	40	5½
Total Forests	88,000,000	261	153	29	79	—	—
Average of all Provinces ..	—	—	—	—	—	14	40

The above figures are taken from *Agricultural Statistics*, vol. i, 1919–20, and from *Financial Statistics*, vol. ii, published in 1920.

gives in its atlas a map showing the forest areas of India; from this it appears that the greater part of India is distant between 10 and 50 miles from forest land. The course of the River Ganges from Benares to the Sundarbans is 100 miles from forests north or south; Cawnpore and Agra are 200 miles from a forest, Delhi 150 miles. These distances are measured as the crow flies. From this map and the table we get a rough idea of the distance one must go in most parts of India to find a forest which could supply the requisite fuel. The 261 districts given in Table I cover a total area of about 977,000 square miles, giving for each district an average area of about 3,700 square miles, which might be contained in a square measuring 61 miles on each side.

It would, of course, be better to grow the forests in each small district, so that the fuel should be within an easy walk of each villager's hut. The question therefore arises, How much land would be required to be set aside for timber-growing in order to supply this fuel? I have read a great many books and accounts of India in order to try to find an answer to this question, but I have not been able to get a thoroughly satisfactory reply. There is a magnificent book on the *Silviculture of India*, in three great volumes, by Professor R. S. Troup, now of the Forestry School at Oxford, and in that he gives an account of a tree imported from Australia, the *Eucalyptus globulus* (this tree grows well on the hills, but will not flourish on the Indian plains), and he describes a well-established plantation, thirty

years old, from which twelve tons of timber could be got every year from every acre. That would supply six families of five persons, or thirty people, and if each of those people had an acre of land, thirty acres in all, the fuel growth would require 1 in 30, or 3 per cent. of their land. It might be possible to induce the cultivators to give up one acre in thirty for the sake of growing their fuel, though they would probably require to be bribed in the first instance until they discovered the great advantage to their crops, and other advantages to their cattle, resulting from the plantation of trees, because this plantation would give the cattle shelter in the hottest months, and might also provide them with green leaves for fodder. It is not probable that the timber would be grown in one small plantation of one acre; probably the plantations would not be less than ten acres in extent, or a still larger unit might be adopted—twenty acres, which would supply fuel for six hundred people. But in some of the more densely populated areas there are two, and sometimes three, persons to one acre. In the latter case the proportion of ground required to grow fuel, if not more than twelve tons is grown in a year on one acre, would be 10 per cent. of the area occupied for cultivation, and it is doubtful if the cultivators would give up that proportion of land, even though their crops were increased 20 per cent. in consequence of the better manuring of the land, and in these cases the fuel would have to be brought in from a distance.

It must be borne in mind that the most densely populated parts of India are crowded because of the favourable circumstances for making a living by agriculture, because there is generally a good rainfall, because it is on low ground where the heat is very great, because the ground is level, which facilitates cultivation, so that in these areas not merely rice, wheat and other kinds of grain will grow, but every kind of vegetation is prolific, and it is probable that bamboos or other canes, or other wood, would grow very fast and yield combustible material. In dry lands, Professor Troup mentions the tamarix as a tree that grows quickly and gives good wood suitable for fuel.

In the afforestation of the Etawah district of the United Provinces, as described by Mr. E. A. Smythies, I.F.S., the plants of which the seeds were sown are as follows: Babul, shisham, teak, tun, haldu, etc., etc., and these show quite handsome plantations at the end of three years, from twice to four times the height of a man. These are in dry situations depending on the rainfall. In each one of the 261 districts, in addition to the cultivated area, there is a large area of land which might be cultivated, and also a large area which it is said is not available for cultivation. This area, not available for cultivation, where it is not town land, water or bare rock, may be sandy desert or jungle, which might be made culturable if it was irrigated or planted with trees, or in other ways adapted by the enterprise of man to some useful purpose. It is probable that some part

of this waste land which is now culturable is not very far from every part of the districts, and as it is now out of cultivation it might be planted with trees for timber without abstracting any land from the cultivated area, and in a period varying from six months to three years, this land, if planted, might begin to yield a considerable amount of wood suitable for fuel. This afforestation in the Etawah district is being carried out partly to save the land from being damaged by erosion, 120,000 acres having already been put out of culture by erosion ; also with the intention of supplying wood for the use of the people either for building, fuel, or other purposes, and partly for the supply of fodder for the cattle in the hot, dry season. The work can be cheaply done, and it is very profitable, because the demand for the wood is so great.

CHAPTER VII

Afforestation—Lowering the level of the Jumna—Benskin, Trowscoed, Elsworth Huntingdon—Cost of afforestation at Etawah—Benefits resulting from afforestation—Forests cut down and burnt down to make room for cultivation; burnt down accidentally—Destruction of forests causes destructive torrents—In a dry country forests do not re-establish themselves without protection—Afforestation very profitable to the nation—Bearing on the question of manure and crops.

THE late Lieutenant-General Arthur Phelps, who lived for thirty years in India, told me that he could not forgive the English Government for not having re-afforested those lands in India which have been denuded of their trees.

In every country in the world where there is a large and growing population there is a strong tendency to destroy the forests. Timbers which have grown for scores or hundreds of years may be very valuable, or the land may be wanted for cattle-grazing or for cultivation, in which case the forests may be burnt down as the cheapest and quickest way of clearing the land. This is the plan now adopted in New Zealand for clearing the land, and forests of enormous value, if their timber could be removed to the place where it is wanted, are burnt in order that flocks and herds may go, or corn be planted, in the place of the trees.

But forests are destroyed not only intentionally, but unintentionally. Fires due to carelessness destroy great numbers of trees. Cattle roaming about the forests will eat up the seedlings and pull up grass by the roots, and so destroy not only the young growth of trees, but the grass which helps to keep the soil together, and then when torrents of rain come the soil, unprotected either by trees or grass, is washed away and the hillside is turned into deep ravines and the plains below are covered with débris, and waste and desolation is the consequence of the deforestation.

Mr. Benskin, of the Indian Forest Service, has written very strongly on this question. He says that in former days the greater part of India was covered with forests, and districts which were formerly sheltered are now bare and desert. In the *Agricultural Journal of India*, page 685, Mr. Benskin, writing of the afforestation at Etawah, in the United Provinces of the same districts described in the previous year by Mr. Smythies, says that the bed of the Jumna has been lowered 50 feet in the last five hundred years by the erosion of the river-bed, due to the torrents in the rainy season rushing down from the mountains in a manner which he considers would not have happened if the forests had remained, because in the forests the water is held up and is let out more gradually. When there are no trees and no grass, particularly when the land has been trampled by cattle, the rain rushes quickly off the ground and pours down in a torrent, and countries where five

hundred years ago there was a fine forest are now, owing to the destruction of the trees and the grass, bare deserts. The desert in the Etawah district was increasing at the rate of 250 acres a year, due to the torrents in the rainy season making deep ravines in the land which was unprotected by any vegetation. He says that the area of cultivation in the Saharanpur Terai has diminished in the last fifty years. We know that in England forests were cut down in order to make charcoal for the smelting of iron, and the same thing has happened in India, where charcoal was used for smelting iron until cheaper British iron was introduced into the country.

In England the plentiful rain has sufficed to make the grass grow, so that the destruction of forests has not deprived us of grass or of water. But in India the conditions are quite different, and the destruction of forests leads to a great deal of destruction of good land. Because damage has been done in the past, there is no reason why it should not be repaired now. The destruction of forests was going on long before the English came and took control of the land, but it went on long after the English came, and perhaps at a greater speed because of the demand for timber for railways and other works, and also because of the increase in population. This increased population would lead to the increase in the number of cattle and goats. Goats are most destructive to trees: where they are allowed to roam about the wood they will destroy the young trees and the shoots and seedlings. Cattle also are destructive to

branches and leaves, and shoots and seedlings, and not only that, but when they are short of fodder they tear up the grass by the roots.

During the last forty years the Indian Government has made great efforts to protect the existing forests from destruction, and they are now managed with a great deal of care and science, so that their destruction has been stopped and some little afforestation has taken place, but not much, because afforestation means expenditure, and the Indian Government has no money to spend on this work, as already explained. The *Indian Forester* is a monthly journal published in Calcutta. In that journal for August 1921, page 337, Mr. Trowscoed refers to the destruction of forests in Cyprus, Greece, Palestine, North Africa, and also in India. He says, speaking of North-Western India: "The forests where the Emperor Baber hunted the rhinoceros are now a waterless tangle of ravines," "the beautiful country along the Foot Hills is now buried under sand and gravel." Kumaun has been made dry "by a race sunk in abysmal ignorance; with fire and axe they devastated their own land." The injury that has been done to many countries by the destruction of forests is now a commonplace, and there is no doubt that it is true that great injury has been done which might be repaired by afforestation.

At the same time it is well to bear in mind that there is another view of the case. Mr. Elsworth Huntingdon, formerly Professor of Geography at the Yale University, says that a great deal of the

deforestation in Asia and Africa is due to a change of climate. He says that in some countries and latitudes and longitudes there is now less rain and more heat than formerly, and claims that the desert has destroyed the forest and not that the destruction of forests has caused the desert. In this he especially refers to Central Asia, Syria, and Palestine.[1] Mr. Huntingdon has given great time and study to the question, and I am inclined to accept his views as true on that account.

His views do not contradict the statement that great harm has been done in many places by the cutting down of the forests, and he would not dispute the fact that trees will grow in a country if they are protected, which would become desert if the trees were allowed to be destroyed. The work of the Indian Forestry Department has proved that afforestation in that country is quite possible, and that it can be done at the present time at a cost of about £2 per acre—that is the cost in the district of Etawah in the United Provinces. From the forests can be got not only timber for building and a great variety of other purposes, but fuel for domestic fires, fodder for cattle and horses, shelter from the blazing sun, regulation of the flood of waters during heavy rains, and protection of the soil from erosion.

Of course it must be borne in mind that whilst the forests may give wealth and protection to the soil of other districts, it may be a place more liable to malaria than a dry plain. Dr. Sir Ronald Ross

[1] *The Pulse of Asia. The Transformation of Palestine.*

has shown how to deal with malaria, and so the fear of that should not prevent afforestation. If the Indian Government was to lay out a large capital for the scientific afforestation of 100,000,000 acres, it would be conferring a great and lasting benefit on the country, and £200,000,000 would yield a large profit upon the outlay. The cost of afforestation as carried out at Etawah is £1,300 per square mile. At present the Indian Government has about 250,000 square miles of forest to deal with, but only 110,000 are really protected by the State. The annual profit is now about £1,200,000 a year, rather less than £5 per annum per square mile of the larger area, but £11 per square mile of the smaller area; but this surplus that is saved over expenses is only a very small fraction of the benefit that is conferred upon the country by the management of the forests: the supplies of timber and fodder, the control of the torrents, and the cooling of summer heats, give benefits to the people equal to ten times the amount of the money surplus earned by the Forestry Department, and there can be no doubt that a bold expenditure upon afforestation would yield to India a very handsome return on the outlay. It is stated by men of experience in India that forests tend to attract rain in districts over which the clouds might pass without condensing if the land was bare and hot, and that afforestation will lead to a more regular and greater rainfall in those places which are now liable to drought.

I have dealt at some length with the question of

afforestation, because it is part of the question of supplying fuel to the cultivators so that they may use their cowdung for its proper purpose, that of manuring the land. All agriculturalists, all agricultural chemists, every practical man knows that the dung of cows, oxen, cattle, sheep, goats, pigs, poultry is the best possible manure for the land. It is not the only manure, and by itself is not always sufficient, but without that manure it is difficult, and sometimes impossible, to keep the land in good condition, because it is not merely the chemical effects of the manure, the nitrogen, the phosphoric acid, the potash that is in the manure, but the mechanical and also the bacteriological effects in this organic material in the soil, because before manure can act upon the land there must be an organic condition which is imparted or maintained by putting in the manure of animals such as those above mentioned.

CHAPTER VIII

Manure, everybody knows it is necessary—River floods provide manure—Succeeding crops of corn impoverish the soil—Minerals necessary: lime, potash, phosphates, also nitrates—Hydro-carbons provided by air and water—Green manure for nitrogen—John Kenny, results of manure on Indian farms—United States experiments, cotton crop, manure required—Kenny continued—Madras Department of Agriculture—Paddy per acre—Agricultural Research Institute, Pusa—W. A. Davis—Indigo, oats, superphosphates—Board of Agriculture, Pusa—Exhaustion of Indian soils—Indian problem solved, Ashburner—Bartle Frere, manure necessary—Supply of artificial manures cost £60,000,000—Cost how repaid—Supply of fuel; plantations, Forestry Department to undertake this—Government agricultural chemists to advise on manures—Complete manures required—The work should be begun at once.

EVERY agriculturalist, every agricultural chemist, every intelligent person who has had to do with land, or has considered the condition necessary for the production of good crops from the soil, knows that it is necessary to manure the land if good results are required. In some places, as in the Delta of the Nile, the land is manured by the flooding of the river every year, which brings down a lot of mud from the mountains of Abyssinia, which flows over the land and fertilises it. The same thing happens in India, where the lands are flooded by the overflowing of the Ganges and the Brahmaputra, and many other rivers. This insures the fertility of the soil, although it is quite possible that even on those lands the addition of manure of another

kind may effect great benefit. But on those lands which are not annually enriched by the deposits of a flooding river it is absolutely essential, if the fertility of the soil is to be maintained, that manure should be added to the land.

The reason is this: The crop of corn that is taken from the land contains materials which are taken out of the land, such as nitrogen, phosphoric acid, potassium, as well as other things more common and less likely to be depleted. These things are essential to the growth of the plant, and after a crop has been repeated for a good many years the soil gets impoverished and good crops can no longer be obtained. Some nitrogen is brought into the soil every year by the rain, but that is not enough to compensate for the amount taken out in the crop. Nitrogen may be restored to the soil by growing crops of a certain kind which extract nitrogen from the air and deposit it in the soil. In India it is a common thing to grow green crops, which whilst green are ploughed into the ground and supply the land with nitrogen. In England, Germany, France, and many other countries it is customary to supply the nitrogen in some mineral form, such as nitrate of soda obtained from Chili, or sulphate of ammonia obtained from gasworks and coke ovens. Without this supply of nitrogen the crops of England and other parts of Europe would rapidly decline. Another most important mineral is potassium, that is essential to the growths of plants. In Germany there are great mines where salts of potassium are

obtained, at Stassfurth. The restoration of phosphoric acid to the soil is essential for every kind of agriculture.

If cows are fed continually on pastures which are not manured with some substance giving phosphoric acid, the milk will go down in quality, and so will the products of milk, like cheese. Neither corn nor vegetables will grow in abundance unless there is a good supply of phosphoric acid. This is well known to the European farmers, who apply it in various forms, superphosphate, ground-phosphate, basic slag. Fifty years ago Peruvian guano was largely used, it was a complete manure, and gave excellent results. But the deposits of guano were soon exhausted, and now only sweepings remain. By the application of these substances the land is maintained in a productive condition, and except for their use British farming would to a great extent come to an end. It is chiefly by the use of these manures that the British farmer is enabled to produce from a field of corn from twice to five times as much as is produced on the average of Indian farms.

For production from the soil it is necessary to have first a good soil, such as it is; second, sufficient water; third, sufficient sunlight; fourth, sufficient heat. The plant itself is chiefly composed of air and water, out of which hydrogen and carbon are obtained. The hydrogen is a constituent of the water, and carbonic acid gas is in minute quantities in the air; these produce hydro-carbonates, which are the chief components of all vegetable and animal matter.

This does not take anything out of the soil. The plants will not grow except with the aid of some mineral substances. Lime, potash, phosphorus are among the chief mineral substances, and these are taken out of the soil by the plant of which they constitute only a minute fraction; and if the plant is afterwards removed, the soil is deprived of those substances; and if the removal of these minerals is continued year after year it is probable that the soil will run short. It very often happens that the amount of lime originally in the soil is so great that it is never necessary to bring lime from other places to recoup the amount taken away with the plants that are removed. But with regard to potash and phosphorus, it generally happens that if repeated crops are taken from the land year after year, these necessary elements will run short, and then the crops will be poor. Nitrogen is also necessary for the growth of the plant. This, too, comes out of the air, and it is necessary to restore it to the land by some other method. The growing of leguminous plants will restore nitrogen to the land. A suitable crop is often sown, and when well grown is ploughed into the land when green; this is effective, but causes the loss of that season. The nitrogen is generally given to the land in Europe in the form of nitrate of soda, or sulphate of ammonia. Phosphorus is given to the land in the form of superphosphates, which may be made from bones or from a mineral, tricalcic phosphate of lime. Phosphate of lime ground small is often given to the land instead of

superphosphates. It does not produce such immediate results, but its effect will be more lasting. Various salts of potassium are found as minerals, and in Europe it is common to give these to the lands where there is a deficiency of potash.

Unless the soil possesses every necessary constituent the crops will be poor. If there is not sufficient potash, the crops will be poor, though everything else is abundant; if there is not sufficient phosphoric acid, the crops will be poor, though everything else is abundant; if there is not sufficient nitrogen, the crops will be poor, though everything else abounds. So that the success or failure of any special manure cannot be judged simply by a trial to see whether or not the crops have greatly improved by it, because it may fail to give good results, not through a deficiency in itself, but because some other manure is required as well.

Therefore for scientific agriculture it is necessary to analyse the soil to ascertain whether there is sufficient of each kind of manure, and what kind is deficient, if any, and then it is only necessary to add that ingredient which is wanting.

In 1912, Mr. John Kenny, Instructor of Agriculture to the Nizam of Hyderabad, published a valuable book entitled *Intensive Farming in India*. On page 133 he gives the result of manure on the production of grain, as shown by experiments at the Burdwan Government Farm. When the land was not manured the output of grain per acre was 1,374 lb., and of straw 2,174 lb. When 100 maunds

(a maund is about 82 lb.) of cowdung, that is rather less than 4 tons per acre, was applied, the amount of grain was increased to 3,556 lb., and the straw to 4,479 lb. When, instead of cowdung, bone-meal 3 maunds, and saltpetre 30 seers, were given, the amount of grain rose to 4,389 lb., and straw to 6,178 lb. per acre.

This shows the immense results that may be got by manuring. But, of course, it will be understood that the results obtained by the application of bone-meal and saltpetre could not be repeated year after year without great additional quantities of manure, because this enormous crop would take out of the land many necessary constituents which the quantities of manure above given do not supply. It probably would be necessary to add potash, perhaps lime, and probably it would be necessary to add ordinary farmyard manure. Still, we see that by suitable manure a crop was increased threefold, and we must bear in mind that this threefold crop is FIVEFOLD the average crop of India.

On page 260 Mr. Kenny gives experiments with paddy on Mr. D. S. Newman's Dry Land, Ranipet. When the land was not manured the yield of grain was 1,084 lb., and of straw 7½ cwt. On one acre of land manured with ashes 2 tons, bone-meal 8 cwt., cattle manure 12 tons, at a cost of 25 rupees (*sic*), the grain (paddy) obtained was 3,484 lb., and the straw 22 cwt. On an adjoining plot of one acre that was not itself manured, but was enriched by the flow of water from the manured land, the grain recovered was 2,216 lb., and the straw 14 cwt.

On one acre unmanured land the value of the grain was 23 rupees 9 annas, and the straw 1 rupee 1 anna 9 pies. On the manured land the excess value of the grain was 52 rupees 6 annas, 9 pies, and straw 3 rupees 4 annas. On the watered land the excess value of the grain was 24 rupees 9 annas 6 pies, and the straw 1 rupee 7 annas 3 pies.

On page 263 Mr. Kenny quotes an experiment with paddy by Mr. G. S. Newman, of Ranipettai. There, with a suitable manure (ground-nut 3 cwt., bone-meal 1 cwt., potash in the form of kainit 1 cwt.), he produced 6,168 lb. weight of grain, and 3,610 lb. weight of straw per acre. On page 265 he gives the result of his study on wet land of very poor quality, and in this case without manure the yield of grain was 408 lb., and straw 9 bundles. With manure, consisting of 1½ cwt. ground-nut, ½ cwt. bone, and 75 lb. kainit, the grain produced was 1,337 lb., and the straw 22 bundles.

Turning to the cotton crop, Mr. Kenny, on pages 333 and 334, gives the results of "experiments made on the peasants' own fields at Barsi in the Deccan." He takes the lint crop as being about one-third the weight of the seed and lint crop combined, and the results are as follows:—

	lb.[1]
1. Unmanured	50
2. Manured with 4 tons cattle-dung	80
3. Manured with nitrate of soda 1 cwt. and superphosphate 1 cwt. and kainit 1 cwt.	150
4. Manured with ground-nut cake 2 cwt. and 2 cwt. each super and kainit	200

[1] From the context it appears that these are weights of lint (cotton) per acre.

It is always possible to get a good crop out of land for two or three years by manures which excite the reserve constituents of the ground, but which exhaust it, therefore for a permanency it is necessary to supply manures which will restore to the ground the necessary minerals, but the ground-nut cake, the super and the kainit give nitrogen, phosphoric acid and potash.

On page 335 Mr. Kenny quotes from reports of the Department of Agriculture of the United States experiments made in the United States, which show that cotton may be grown with the following weights per acre :—

PLANT FOODS TAKEN FROM THE LAND BY THE CROP.

Crop.	Weight of Crop.	Nitrogen.	Phosphoric Acid.	Potash.
	lb.	lb.	lb.	lb.
Lint	300	0·72	0·18	2·22
Seeds	654	20·25	6·66	7·63
Pods	404	4·54	1·14	12·20
Leaves	575	13·97	2·57	6·57
Stalks	658	5·21	1·22	7·74
Roots	250	1·63	0·38	2·75
Total	—	46·32	12·15	39·11

Mr. Kenny remarks that, as regards the lint, it takes so little out of the ground, that if all the rest of the plant were restored to the earth the land would not require manuring, but of course that is not possible. The seeds are used to a great extent

for cattle food, and the rest of the plant is probably used to a great extent for various purposes.

Coming to the wheat crop on pages 364 and 365, Mr. Kenny quotes Dr. J. W. Leather, the Agricultural Chemist of the Indian Government. Writing in the *Agricultural Ledger* on Indian manures in 1897, he says: "The general conclusion which we may draw from these experiments (the increase in the harvests due to cattle manure) is that, with an application of 6 tons per acre of cattle manure, there will be obtained an increase of some 300 to 400 lb. of wheat per acre in the North-West Provinces, or Bengal, and at Nagpur from 200 to 300 lb." These results are unsatisfactory, as showing only a small return for the manure, and point to the conclusion that the soil required some other manure in addition to make it productive. It is also to be noted that in the quotation it is not stated whether the 6 tons were fresh or dry. Very likely it is fresh manure, because 6 tons of dry manure would require for its production a pair of well-fed cattle in one year, and there are not enough well-fed cattle in India to give more than one-quarter of this weight of dry manure for every cropped acre every year. In dealing with human excreta, preserved in the form of poudrette, Dr. Leather gives the result of fifteen years' trial:—

No manure ..	.. Average grain 1,083 lb. per acre.
Poudrette ..	.. Average grain 1,603 lb. per acre.

On pages 364 and 366 Mr. Kenny quotes Mr. T.

Basu, Assistant to the Department of Land Records of Agriculture, on the Dumraon Farms. Writing in the *Agricultural Ledger*, No. 10, of 1893, he gives the result of five years' experiments: With no manure the average crop of wheat was 10 maunds (820 lb.) per acre; with manure, in the form of 3 maunds of saltpetre (supplying nitrogen) per acre, the average result was 19 maunds per acre. It must be noted, however, that saltpetre is not a complete manure, and will exhaust the soil unless other manures are added, and this is shown by the continuous reduction in the crop during the five years of the experiment. The first year of the application of saltpetre the crop was 27 maunds per acre, in the last year it was a little over 15 maunds.

On page 376 Mr. Kenny quotes the results obtained in England at Rothamsted. After seventy years without manure the land continued to produce from 10 to 15 bushels of wheat per acre, each bushel weighing 60 lb. With 14 tons of farmyard manure the production is 33 bushels.

Mr. Kenny writes at some length to show the need for manure in growing sugar-cane, tobacco, tea and coffee. In dealing with coconut trees, on pages 504 and 505, he quotes the owner of an estate as saying that he has raised the average crop from 10 nuts per tree to 135 nuts by careful manuring.

In dealing with potatoes on page 567, Mr. Kenny quotes the Annual Report of the experimental

work of the Dharwar Agricultural Station, 1908–9, which gives results obtained with potatoes at Belgaum " on sandy loam—poor soil." Unmanured, the harvest of potatoes was 145 bushels per acre. With a manure per acre consisting of 158 lb. Chili saltpetre, 440 lb. superphosphate and 158 lb. sulphate of potash, the harvest was 349 bushels.

A paper entitled *Operations of the Department of Agriculture*, Madras Presidency, for the official year 1920–21, Madras Government Press, 1921, pages 8 and 9 gives some yields of rice in the following words : " On the main paddy tract at Central Farm, Coimbatore, the variety Poombalai gave the best yield, that is 3,234 lb. of grain per acre on 10 acres. It is interesting to note with regard to paddy, testing various kinds, that the Poombalai crop gave 3,009 lb. grain and 3,064 lb. straw ; and the Sadia Sambu gave, grain, 2,781 lb., and straw, 4,805 lb.

" The Agricultural Research Institute at Pusa " has published *A Study of the Indigo Soils of Bihar*, on " the urgent necessity of immediate phosphate manuring if crops are to be maintained," by W. A. Davis, D.Sc., A.C.G.I., Indigo Research Chemist to the Government of India, published in 1918. This paper shows how the continuous cropping for indigo has resulted in the impoverishment of, and the exhaustion of the phosphoric acid in, the soil, and consequently the failure of the indigo crops. On page 25 he quotes Mr. M. M. Mackenzie, at Sapaya, speaking of the enormous benefits to the Bihar soils in the application of superphosphates. He manured

the lands with superphosphates plus green manure, and got the following crops of oats :—

AVERAGE PER ACRE IN MAUNDS OF 80 LB.

1st year	..	..	..	..	12	= 960 lb.
2nd year	..	..	..	..	19·5	= 1,560 lb.
3rd year	..	..	..	..	23	= 1,840 lb.

This combination of manures supplied nitrogen and phosphorus—presumably there was sufficient potash in the ground. On page 32 Mr. Davis states that at Pusa the application of superphosphates only had raised the crop of maize from " 10 maunds to 15 maunds per acre." By continued green manuring plus superphosphates the crop of maize was raised from 6 maunds per acre to 19½ maunds per acre. He says that " in 1899, at Dalsingsarai, superphosphate manuring increased the crop of mustard seed from 6 maunds to 27 maunds per acre, that is a gain of 21 maunds per acre."

In the *Proceedings of the Board of Agriculture at Pusa*, December 1, 1919, page 84, Anstead, Norris and Samson reported that " India suffers from soil exhaustion " due to " want of manure "—" failure to use human excreta," and also suffers from exports of seeds, oil-cakes, bones, and they advise the stoppage of these exports. On page 125 the following figures are given : With no manure the crop of maize was 752 lb., straw 1,732 lb. With green manure and superphosphates the crop was 1,458 lb. grain and 2,841 lb. straw. In the case of oats without manure the grain crop was 562 lb. and straw 1,175 lb.

With green manure and superphosphates the crop was, grain 1,451 lb. and straw 2,330 lb.

In a book called *The Indian Problem Solved*, published by Virtue, Spalding & Co. in 1875, the author quotes the evidence of Mr. Ashburner, C.S.I., Revenue Collector, to this effect: "The present production does not amount to one-quarter of what the land ought to produce. The want of proper manure is one thing, the ignorance of proper methods of cultivation is another." "Very little has been done to utilise night soil"; there is no prejudice against its use. The Ryots "want capital." The expenditure of 18 rupees per acre on manure caused the following increases in the amount of grain produced per acre. The increase varied from 540 lb. up to 900 lb. of grain, and the weight of straw increased from 2,808 lb. to 7,380 lb.

Sir Bartle Frere, giving evidence before a Select Committee in 1871, said: "No system of mineral manuring has been attempted in India. There is a great waste of manure in fuel owing to the want of firewood. The forests have been recklessly cut down."

It is very easy to go on quoting men of great eminence who have declared that one of India's chief wants is manure for the soil in order to maintain its fertility, and in order to increase the crops that are now given. Manures of many kinds in great quantities are necessary, and among these, so far as it goes (and it is a long way short of the need), one of the best for increasing the fertility of the soil

is the cowdung that is now used for fuel. It is therefore necessary to supply the cultivators with wood or coal for their fuel requirements. This could be done almost immediately if the Government were prepared to incur the expense of supplying them with wood or with coal, bringing the wood from a distance, or the coal from a distance, as the case might be.

If plantations were immediately begun in every district, in two or three years' time there would be a sufficiency of wood grown on the spot, and so save the cost of transport; and if at the same time a general system of afforestation was started and carried out with energy, there is no doubt that in a few years from this time Indian agriculture and Indian prosperity would be on the up-grade, and the rulers of India might look with satisfaction on the wealth of the people as it increases, and know that the people were well fed and that British rule was creditable to us and to the British nation.

Of course the question immediately arises, How much would it cost to supply this wood or this coal whilst the plantations were growing? Probably to supply all the cultivators with the fuel they require at once would cost at the rate of £20,000,000 to £30,000,000 a year. On the other hand, there is another method. Instead of supplying the cultivators with fuel so that the land might be manured with cowdung, they might be supplied with artificial manure. Sufficient artificial manure to supply the land whilst the cowdung was being burnt would

require, for superphosphates, seven million tons at £3—that is, £21,000,000 a year; for potash in the form of kainit, two and a half million tons at £3—£7,500,000; and for nitrogen, four million tons of Chili nitrate at £8—£32,000,000; total, £60,500,000—say £60,000,000 a year in round figures.

If those amounts of phosphates, potash, and nitrates were applied with due science every year to the land of India, it would produce a wonderful increase in their crops, probably double them. But it is not to be supposed that this can be done all at once.

The world is not prepared to supply to India those quantities at once, because other people would have to go short. Neither would it be possible if these artificial manures were actually to be delivered in India to use them all at once in a scientific manner, and it would be a pity to use them in a wasteful manner.

There is no reason why a beginning should not be made immediately. If the Indian Government should decide that it would undertake to increase the prosperity of Indian agriculture, I will point out a way in which it could be done. Instructions should at once be given to the Forestry Department and to the officials in charge of each district in the country to take in hand the plantation of sufficient trees or canes or other plants which would supply fuel so that the people should not be obliged to burn cowdung for fuel; and if the Government guaranteed the expense, there is no reason why a great deal of

planting should not be done in a few months, and year by year the quantity would gradually increase until in from five to ten years from now there should be sufficient fuel grown in or near each locality where it was required, and in those localities where the land was too valuable to use for growing wood fuel, then suitable roads or railways should be made to convey the fuel from the nearest suitable plantation to the towns and villages where it was required, or in places where it was more convenient and economical coal might be supplied.

As the plantations became capable of supplying fuel, the cultivators should be told that they will be supplied with wood for fuel free of cost on the understanding that they will use the cowdung as manure, and they should also be given to understand that it is the intention of the Government that if the use of this cowdung as manure produces improved crops, and if that is admitted by the cultivators, then one-half the improvement in the net results of cultivation, not one-half of the increased gross produce, one-half of the increased net produce should be paid to the Government in return for the fuel which it gave to each cultivator, until the amount equalled the cost of the fuel. When the cultivators became quite confident that they will not be taxed for using the wood fuel, there can be little doubt that most of them would gladly use it and increase the fertility of their land by the cowdung set at liberty for that purpose.

Even if all the dung is used as manure, it is not

half the necessary quantity, and there is no doubt amongst those who have analysed the soil of India in many places, and who have noticed the crops, and noticed the effects of manures of different kinds, that the mere increase in the amount of cowdung will not supply all the deficiencies of the soil. The soil is notably deficient in phosphoric acid over the greater part of India, and therefore phosphates must be applied, either in the form of superphosphates, or of bone-meal, or of ground phosphate rock, or basic slag, or from some other source. Phosphates in a form available for plant life must be put into the soil.

To a less degree, a great deal of the soil of India is short of potash, that does not apply everywhere and always, but potash is required in a great many places. And with regard to nitrogen, there is no doubt that in the greater part of India the soil is deficient in nitrogen, and if first-class crops are to be raised, nitrogen must be supplied. It may be in the form of nitrate of soda from Chili, or sulphate of ammonia, or in the form of nitrolin, or some other compound of nitrogen and lime, but this must be supplied in some form if India is to do as well as it might do.

But the Indian cultivators have had the chance of buying these artificial manures if they wanted to buy them. Well, some do buy these manures, or, if not these identical manures, they buy others that have the same effect. But the enormous majority of the cultivators do not buy any manures at all, at any rate they do not buy artificial manures.

Now, I suggest that the Government, through its Agricultural Department, its learned agriculturalists and agricultural chemists, and directors of experimental farms, should have complete analyses made of the soil in every locality, so as to discover what constituents of plant life the soil has in abundance, and of what constituents there is a deficiency. Chemical laboratories should be established in every district so that the cultivators may bring samples of their soil to be tested, so that they may receive sound advice as to the best kind of manure to apply, and, of course, an experienced agriculturalist would advise upon the result obtained by the chemist. Then the Government should offer to the cultivators these manures free of charge, but there should be an agreement that if and when it is proved beyond doubt that the use of these artificial manures has materially increased the amount and value of the crops, that then out of the net profits the cultivator gets after paying all the necessary expenses, one-half should be paid to the Government to repay the cost of the artificial manure supplied, and this charge is not to be a permanent charge, but a temporary charge till the cost of the fertilisers has been repaid. Of course, after the use of manures is well established, and a distinct increase in the crops has come about, and the condition of the cultivator makes it possible, then there would be no reason why the valuation for revenue purposes should not be increased so as to help to pay the cost to the Government.

It will of course be borne in mind by every

practical agriculturalist that if by the stimulation of artificial manures there is a great increase in the production of the soil, more grain, more straw, more roots, more rice, more cotton, more oil, etc., then there will be a greater demand upon the soil and a greater extraction from the soil of those constituents which are necessary for its fertility. Therefore it is not sufficient to supply manures which are only stimulants, like nitrate of soda or sulphate of ammonia. These would do more harm than good in the long run, unless at the same time other manures are applied which will restore to the soil the necessary constituents, that is why phosphates must be applied and potash, and in some places lime. That is why farmyard manure is so valuable, why fish manure gives such good results; a complete manure is what must be applied to the soil. Such a complete manure was found in Peruvian guano, such a complete manure is sometimes found in stableyard and cow-yard manure, but not always; cowdung contains the greater part of what is required, and the application of manure in that form supplies the organic material which is required to make the soil work so as to encourage the growth of vegetation.

The reason why cowdung is not always a complete manure is this: The milk of the cow contains a good deal of phosphorus, and this milk is not restored to the soil, it is consumed for the most part by human beings, and therefore the phosphorus has to be found from some other source in order to restore the fertility of the soil. Phosphoric acid is needed

for maintaining the fertility of meadow land, and this led to the first use of superphosphates in order that the milk supplied by the cows might have the requisite amount of phosphorus in it. This it would not have if the land was deficient in phosphorus, and land manured only with cowdung will, in course of years, become deficient in phosphorus, and that is one reason why India now requires phosphates applied to its land.

Every practical and scientific farmer knows that whilst manure is necessary, it is not the only thing that is necessary to produce good crops. One of the chief things that is necessary is proper tillage. The Indian farmer, as a rule, understands how to till the land. Another thing that is necessary with some crops is the proper spacing of the seeds. For instance, with maize it has been discovered that with proper tillage and proper spacing of the seeds the yield may be very largely increased quite irrespective of any manure that is applied. But then, of course, we are in this dilemma, if by the most careful tillage, if by the spacing of seeds, if by the selection of the best seeds, we succeeded in increasing the crops, then we also succeed in increasing the drain upon the soil and hastening its exhaustion, because these crops will take away from the soil necessary constituents, and therefore the better the agriculture, the better the tillage; the more scientific the spacing of the seeds, the better the seeds; the more careful selection of the plants, the more necessary does it become to supply those manures which

will supply the soil with its necessary constituents. And yet there are some men in high places in India who think that by careful selection of seeds and proper tillage they can do without the application of an increased supply of manure to maintain the fertility of the soil; but every agricultural chemist, and every other man who has carefully studied the subject, knows that they will discover their mistake in a few years' time.

CHAPTER IX

Table showing quantity and value of Indian agricultural production, also value of all other production—Total value £1,878,636,000 per annum—Explanations of Table—India might become a wealthy country—Its income might be increased £1,550,000,000 a year—This is worth consideration. Tables II, III, IV, V, VI, VIA, VII.

I WILL now try to show the enormous importance of the question of fuel and manure, both farmyard manure and artificial manure, by means of the following Tables, II, III, IV, V, VI, VIA, VII, which have been produced by reference to the Government statistics of agricultural production and the Government prices of the various productions. The agricultural statistics give the acreage of each crop, and they give the total production of a great many of the crops. For some crops the Government give no figures of production, and I have therefore had to make an estimate. But the great bulk of the figures are simply Government figures as to the amount of production and Government figures as to the value of the produce in rupees.

As regards cattle, the figures are taken from the Government statistics, but as regards the annual value of the cattle the Government gives no statistics.

I have therefore had to make an approximate estimate of the value, and in making that value in addition to the value of the production of the land, I am not valuing that production twice over, because the bulk of the value given by the production of the soil is for grain and other things which the cattle do not consume in a very large proportion. The fodder, of course, they do consume, but I think I have made allowance for that in the value I have put upon the services of the bull and cow and other animals. The production of the forests, the salt pans, the mines and fisheries are to a great extent taken from the Government statistics; where those fail, the value of the production has been roughly estimated, and all the figures are round figures. With regard to the fisheries, I have not been able to find sufficient statistics, but I have just made a rough estimate. The figures in Tables IV, V and VI show that (exclusive of minerals) the PRODUCTION FROM THE LAND AND WATER IS IN ROUND FIGURES WORTH MORE THAN £1,500,000,000 A YEAR, at the rate of production and at the prices ruling in the year 1919–20 for grain and other agricultural produce. The number of cattle is for the year 1917–18, checked by reference to later figures. The forest production is for the year 1918–19. Salt production for the year 1917. The production of the mines, fisheries, rubber, saltpetre, lac and petroleum for the year 1919. Subsequent to that time, so far as the figures go, up to January 1922, the prices have not fallen. Though undoubtedly the prices of 1919 were much higher

han pre-war prices, I find it difficult to make a reduction in the valuation so long as the present prices keep up; there has been a tendency for the prices to rise. There is no doubt that many of the prices in 1919 were 30 per cent., 40 per cent., 50 per cent., and up to 100 per cent. more than the prices of 1913, and when I looked at the prices for 1921 and the beginning of 1922 I fully expected to see a great reduction of price, but I found out that I was mistaken, and so far I have seen no evidence to justify me in making a reduction. For some reasons one may expect that prices will tend to continue to be much higher than in 1913. There is no doubt that Russian production of corn will be much less than it used to be for many years to come. There is no doubt that the population of the United States and Canada is rapidly increasing. The same can be said of the Argentine Republic, and this rapid increase in population in those great corn-growing countries will tend to keep up the price of wheat, and that will have a tendency to keep up the price of other grain, such as rice.

If any person likes to prophesy that in five years' time the prices of all this grain and other production will be much less than they were in 1919, I find no fault, and I say, if you like to reduce my estimates of agricultural production by one-fifth, take off £300,000,000, and that will still leave the substantial figure of £1,200,000,000 as the value of the annual production.

But in addition to the value of the production

from land and water, which includes the production from the mines, there is the value of the manufacturing produce. I have made a rough estimate of this. Of the working population that produce new things, nine out of ten are engaged in agriculture or kindred work, the tenth is engaged in manufacture. Well, I say that those who are engaged in manufacturing have the aid of the steam-engine and of science to help their produce, and therefore it is highly probable that as regards pecuniary value their work per head is twice that of an agriculturalist. Therefore this one-tenth can do work of the value of one-fifth, and therefore if the production from the land worker is £1,585,000,000, I give one-fifth of that, or £317,000,000, as the value of the production of the manufacturing worker. This manufacture includes corn mills, tobacco mills, sugar mills, spinning, weaving, dyeing, iron-working, brass-working, building, and many other things. Adding this manufacturing value to the agricultural value, I get a total production of £1,900,000,000 worth, or adopting the figures in Table VII, £1,902,936,000 worth, for the work of the population of 247,000,000 people who are under the direct British Government. This gives a value per head of about £7·6, or £7 12s. a year, or five pence a day for every day in the year for every man, woman, and child.

Taking the wealth production in the United Kingdom in the year 1920 as £2,500,000,000 and the population as 47,000,000, that would give for that year a production per head of about £53, or nearly eight times as much as the Indian income

per head. 1920 is the last year which we have experienced in the United Kingdom, where there has been no great interruption to work. In 1921 production was seriously damaged by the great coal strike. Nevertheless we know that prices in the United Kingdom have fallen very heavily, and it is quite possible that the value of production in the United Kingdom for the year 1922 will be less than £2,000,000,000 at 1922 prices, and in that case the production per head of the population will be about £43 per annum, which is about six times the amount per head of the production of the people in India.

If the valuation in this table is correct, then an increase of 10 per cent. in the value of the agricultural produce, including cattle, would amount to about £155,000,000 a year, and 20 per cent. to £310,000,000 a year, 30 per cent. to £465,000,000 a year, and 40 per cent. to £620,000,000 a year, and 50 per cent. to £775,000,000 a year, and yet, large as these figures seem, it is quite certain that if the steps which I have indicated are taken there is no doubt that the production on the average of all the agricultural produce, including cattle, might be increased 30 per cent. or 40 per cent. in a very short time, and it is quite reasonable to expect an increase of 100 per cent. in the production of the soil, so far as the production per acre is concerned. But an increase in agricultural production of 100 per cent., which the evidence I have quoted shows to be quite a moderate estimate of what is practicable, because the present production per acre and per man is so

small, means, if the same prices are maintained, AN INCREASED VALUE OF £1,570,000,000 A YEAR.

This is what I ask the statesmen of India and of England to consider.

I ask the Indian patriots to consider this. Surely it is worth considering! Surely that would be better than quarrelling about trifles!

People are so fond of quarrelling.

The excitement is so attractive.

But it is not profitable.

Prove the evidence which I have quoted, and the volumes of evidence which I have not quoted, to be false if you can!

But if you have to admit that it is true, then here is Wealth, Health and Happiness for you and all your people.

But, of course, as the production per acre increases, the price per ton or per maund or per lb. will tend to go down. If the produce of the soil is doubled, the rupee will buy a great deal more than it buys now. The question that would arise would be this, Will the people and cattle of India consume it, or will some of it be exported?

Now, no doubt many things could happen. Some plan will have to be adopted for the storage of grain of different kinds. There are many old-fashioned ways of storing corn; some of these might be adopted. Mr. Clifton West has patented an entirely novel method. First he crushes about 10 per cent. more or less of the grain, then he mixes the crushed and whole grain, then he heats the mass to 160° Fahr.,

then by hydraulic presses he produces solid lumps of about 1 cwt. each. The weevils and their eggs are killed by the heat, and mice and rats cannot bite it. If this patent proves successful, it provides a suitable means of storage which would enable the people to live comfortably during a season or several seasons one after the other when there was a failure or partial failure of the rain, instead of the present miserable system of starvation or semi-starvation in consequence of the horrible system under which they now live, which also entails the starvation of the cattle. Some of the extra production would be exported, with which they could buy luxuries and necessaries of various kinds, and some of the money received would be available for public works of all sorts, including large hydraulic power installations and other works of great value.

On the other hand, it is quite possible that there will be a less area of land cultivated, unless the increase of population would require a greater amount of food than is required by the present population.

With the increased production of the soil the cattle will be better fed, their number increased 50 per cent., and during the hot dry season there would be better shelters in forests and plantations, and their labour would be more effective in every kind of work. And as a consequence of the extra production of food all other kinds of work would be stimulated, mines, manufactures of every sort, and India might become what perhaps it has never really been at any previous period, a wealthy country.

TABLE II.

Extracted from "Agricultural Statistics of India, 1919–20" (No. 1531), and "Statistical Abstract," 1918–19.

INDIA.

Total area, including provinces under direct British control, States and agencies, 1,802,657 square miles, or about 1,152,168,000 acres.

The total population by census of 1921 is 319,000,000, or about 177 persons to the square mile on the average.

(This compares with the United Kingdom area, about 121,000 square miles, with a population of about 47,000,000, or about 388 persons to the square mile.)

Area of included States and agencies, about 709,600 square miles, or 452,000,000 acres, with a population of about 72,000,000, or about 100 persons to the square mile.

Area of provinces, 1,093,000 square miles, or about 700,000,000 acres, with a population of about 247,000,000 persons, or about 220 persons per square mile.

The above area of the provinces contains about 116,000 square miles, or about 75,000,000 acres more than is dealt with in agricultural statistics, from which Baluchistan, the Andamans and some other territories are omitted. A population of, say, half a million is in the omitted areas. The remaining area is about 977,000 square miles and the population about 246,500,000, or, say, 250 per square mile.

Area of provinces of which agricultural statistics are given :—

	Acres.
Area according to survey is	625,149,442
Area according to village papers	622,468,276

The above area is divided approximately as follows :—

Forest	88,323,000
Not available for cultivation (includes towns, roads, mountains, water, deserts, etc.)	145,770,000
Culturable waste other than fallow	113,415,000
Current fallows	52,135,000
Net area actually sown	222,825,000

(It is interesting to note that the area sown is only a little over one-third of the total area, while in the United Kingdom the area cultivated is 59 per cent., or nearly two-thirds of the total area.)

	Acres.
The area of crops shown in Tables III, IV and V is	271,136,000
(The reason for the excess in area is that two or three crops are sometimes raised from the same area in one year.)	
On the above area irrigation by tanks, canals, wells, streams, etc., is done on about	49,000,000
The area of crops irrigated at both harvests is ..	53,000,000

TABLE III.

Extracted from "Agricultural Statistics of India, 1919–20," Vol. I (No. 1531).

Irrigated Area.	Land, Acres.	Crops, Acres (both Harvests).
	About	About
In the Punjab	13,000,000	13,000,000
In Madras	10,000,000	12,000,000
In United Provinces—		
Agra	8,000,000	9,000,000
Oudh	3,000,000	3,000,000
Bihar and Orissa	6,000,000	6,000,000
Sind	3,000,000	3,000,000
Other Provinces	6,000,000	7,000,000
Total	49,000,000	53,000,000

Total Area of each Crop Irrigated, including both Harvests

	Acres (about).
Rice	19,000,000
Wheat	10,000,000
Barley	3,000,000
Jawar	1,600 000
Bajra	1,200,000
Maize	1,100,000
Total	35,900,000
Other cereals and pulses	6,200,000
Sugar-cane	1,900,000
Other food crops	1,500,000
Cotton	2,800,000
Other non-food crops	4,700,000
Total	17,100,000

TABLE IV.

(All figures only approximate.)

Crops raised in British India, extracted from "Estimates of Area and Yield of Principal Crops in India 1919–20" (No. 1344), 1921, and "Prices and Wages, 1920" (No. 1263) and 1922 (No. 1512).

Crop.	Acres.	Yield in One Year.					
		Total Weight. Tons.	Lb. per Acre.	Price per Maund. Rupees.	Price per Ton. Rupees.	Price per ton. £	Total Value. £
				R. A.			
Rice	78,245,000	33,551,000	960	7–12	191	14	470,000,000
Wheat	29,976,000	10,092,000	750	6–8	178	11·9	120,000,000
Barley	7,415,000	3,201,000	960	4–11	127	8·5	27,208,000
Jawar	22,452,000	5,631,000	560	6–3	170	11·25	62,348,000
Bajra	14,541,000	2,800,000	450	6–9	180	11·9	33,320,000
Gram	12,614,000	3,685,000	660	6–0	162	10·8	48,000,000
Maize	6,616,000	2,469,000	835	5–0	135	9	22,221,000
Ragi and other food grains and pulses, estimated weight ..	35,000,000	9,375,000	600	5–0	135	9	84,375,000
Total	206,859,000	70,804,000					859,472,000

Linseed	3,101,000	433,000	313	12–0	324	21·5	9,309,000
Rape and mustard	6,016,000	1,174,000	437	11–0	300	20	23,480,000
Sesamum	4,163,000	480,000	258	15–0	400	27	12,960,000
Ground nuts	1,155,000	800,000	1,551	say	£4 per	acre	4,620,000
Other oil seeds estimated, say, 300 lb. an acre	1,690,000	226,000	300	say	£3 per	acre	5,070,000
	16,125,000	3,113,000					55,439,000
		Raw Sugar.					
Sugar-cane	2,647,000	2,992,000	2,531	9–0	243	16·2	48,000,000
Fruit, vegetables, roots for food, estimated weight	5,680,000	2,540,000	1,000	say	£4 per	acre	22,720,000
Grand Total	231,311,000	79,449,000			Grand	Total	985,631,000
Add acreage from Table V ..	39,825,000						
Total cultivated ..	271,136,000						

TABLE V.

All figures are only approximate; the word "say" means that the figure given is the author's estimate, though it may be founded on authority.

Crop.	Yield in One Year.					Value, £
	Acres.	Weight of Crop.			Values per lb. or per cwt. or per bale or per acre in pence, rupees, and pounds.	
		Tons.	Lb.	Lb. per Acre.		
Tea	691,000	168,000	377,000,000	550	Per lb. 8d., £$\frac{1}{30}$	12,568,000
Cotton	23,070,000	1,040,000	2,336,000,000	100	Say 230 Rs. per bale of 400 lb. 5,840,000 bales at £15$\frac{1}{3}$	89,500,000
Jute	2,839,000	1,530,000	3,433,000,000	1,200	50 Rs. per bale of 400 lb. 8,482,000 bales at £3$\frac{1}{3}$	28,275,000
Other fibres, weight estimated ..	1,690,000	226,000	507,000,000	say 300	Say 4d. per lb., say £$\frac{1}{30}$	8,450,000
Indigo	246,000	2,000	4,770,000	20	44,000 cwt. at 600 Rs., £40	1,760,000
Other dyes ..	611,000	4,000	9,160,000	say 15	Say £3 per acre	1,833,000

Coffee	95,000	15,000	33,250,000	350	Say £8 per acre	760,000
Tobacco	1,011,000	541,000	1,213,200,000	1,200	Say £8 per acre	8,088,000
Opium and seed	221,000	25,000	57,670,000	20 opium 250 seed	Say £8 per acre	1,768,000
Other drugs ..	212,000	19,000	42,400,000	say 200	Say £5 per acre	1,060,000
Fodder crops ..	8,193,000	3,650,000	8,193,000,000	say 1,000	Say £2 per acre	16,386,000
Roots not for food	946,000	422,000	946,000,000	say 1,000	Say £2 per acre	1,892,000
Rubber, see *Review of Trade* for 1919–20, also *Seaborne Trade* for year ending March 31, 1920	—	6,000	12,599,000	—	The export value in 1919–20 as given is about 21 pence a lb.: this is a high value but is lower than that given for any preceding year	1,125,000
Total ..	39,825,000	7,468,000	17,165,049,000	—	Total ..	173,465,000

Forests, from *Statistics of British India*, vol. ii, *Financial Statistics*—

Timber and fuel	344,000,000 cubic feet	say 3,000,000
Canes and minor produce	say 100,000,000 cubic feet	
Lac, see *Review of Trade*, 1919–20, 379,000 cwt. exported, also *Commercial Statistics*, 1921, vol. i, p. xxi.		say 5,000,000
Grand Total		£181,465,000

TABLE VI.

Extracted from "Agricultural Statistics," vol i. 1917–18 (No. 1150), 1920.

The *Agricultural Statistics*, vol. i. 1918–19 (No. 1378), 1921, show about the same numbers as the preceding year, which seems to show that the famine of 1918 was subsequent to the enumeration of the cattle.

The *Agricultural Statistics*, vol. i. 1919–20 (No. 1531), 1922, show a reduction in numbers of—

Oxen and buffaloes	about	1½ per cent.
Sheep	,,	3 per cent.
Goats	,,	27 per cent.
Donkeys	,,	10 per cent.
Camels	,,	18 per cent.

The figures of 1917–18 are adopted, as it is probable the numbers will be quickly restored.

LIVE STOCK.

	Numbers.	Each Animal.		Annual Value.[1]
		Value per Day.	Value per Year.	Total Annual Value.
		Pence.	£ s.	£
Bulls and bullocks	49,332,000	2	3 0	147,996,000
Cows	37,471,000	2	3 0	112,413,000
Bull buffaloes	5,583,000	2	3 0	16,749,000
Cow buffaloes	13,653,000	2	3 0	40,959,000
Young cows and buffaloes	43,073,000	—	say 1 0	43,073,000
Camels	500,000	2	3 0	1,500,000
Total	149,612,000			

Sheep	22,894,000	½	10	11,447,000
Goats	33,166,000	½	10	16,582,000
Donkeys	1,534,000	½	10	767,000
Total	57,594,000			
Horses and ponies	1,681,000	1	1 10	2,521,000
Mules	71,000	1	1 10	107,000
Total	1,752,000		Total	394,114,000
Fisheries.—Estimate, say, one million men engaged on the average all the year round, value of their work, say, 8d. a day for 300 days = £10 a year				10,000,000
Grand Total	208,958,000		Grand Total	404,114,000

SUMMARY.

	£
Table IV	985,631,000
Table V	181,465,000
Table VI	404,114,000
	1,571,210,000

[1] The values are estimated by the author.

TABLE VIa.

In order to estimate the amount of dung available for manure the following calculation is made:

The weight of dung of 1 ox or 1 camel is taken as 1—their number is		149,600,000
The weight of dung of 1 horse or pony is taken as ⅛—their number is	1,752,000	1,200,000
The weight of dung of 1 sheep, goat or donkey is taken as ⅓—their number is	57,594,000	19,200,000
Total		170,000,000

The total dung is taken as equivalent to that of 170,000,000 oxen.

TABLE VII.

MINERALS.

Statistical abstract given year 1919—		Annual Value. £
Coal, tons	22,628,000	6,746,000
Salt, tons	1,763,000	1,113,000
Manganese ore, tons	535,000	1,024,000
Gold, oz., 507,000, gives value in abstract £1,504,000, seems too small, say		2,000,000
Saltpetre, tons	17,550	314,000
Petroleum, gallons	305,652,000	1,223,000
Mica, *Review of Trade*, year 1919, 60,000 cwt., say		600,000

EXTRACTED FROM "COMMERCIAL STATISTICS" (1921).

Iron ore, chromite, tin ore, silver, wolfram, lead, monazite, rubies, gadestone, etc., say	1,600,000
	14,620,000

	Acres of Crops.	Tonnage of Crops.
Table IV	231,311,000	79 449,000
Table V	39,825,000	7,648,000
	271,136,000	87,097,000

SUMMARY.

	£
Table IV. Corn, oil, sugar, fruit and vegetables	985 631,000
Table V. Tea, coffee, cotton, jute, tobacco, indigo, other fibres, other dyes, opium, other drugs, fodder, crops, roots, rubber, forests, lac	181,465,000
Table VI. Oxen, buffaloes, camels, sheep, goats, horses, ponies, mules, donkeys, fisheries	404,114,000
Table VII. Coal, salt, manganese, gold. mica, saltpetre, petroleum, iron ore, other minerals, metals and jewels	14,620,000
Total	1,585,830,000
Add 20 per cent., or one-fifth for manufactures	317,106,000
Grand Total	1,902,936,000

CHAPTER X

Indian landowners exempted from income tax ; take major portion of rent—If production increased, labourers will get better pay —This book does not deal with controversial political problems —All governments are necessarily bad, but some are worse than others—Scope in India for all the energy of the people in combating natural difficulties of soil and climate and utilising enormous natural resources.

If the Indian people should acquire wealth in the way that I have pointed out, the next question that arises is, how is that wealth to be shared? At the present moment there are in India a great number of people who take rent and do not do any corresponding work in return. This is particularly the case in Bengal, where under the permanent settlement the revenue remains much the same as a hundred years ago, but the rents are now four-fold what they were then. We have created a class of landowners. Now, some of these landowners make a good use of their money, and help on the agriculturalist: they erect buildings, banks, post offices, and do other work of great value, for which they get a return, but there are others who do not do these things.

What seems so extraordinary to an Englishman who comes to India and studies the financial situation is that the Government, which is always short

of money, which puts a tax on such a thing as salt, which is an article of necessity for the poorest people, exempts the receivers of rent from all income tax upon those rents derived from the land.

In England our landowners are very heavily taxed, and the Chancellor of the Exchequer would never dream of exempting a landowner from income tax. With income tax, super tax and death duties, the more wealthy landowners pay to the Government more than half their income. Probably, taking the death duties into account, there are few landowners who pay less than 8s. in the £1 of their net incomes in taxes to the Government, and there are others who pay something like 13s. in the £1. Whereas in India the happy landholder is by special legislation exempted from the need of paying any income tax at all. In England our landowners have done a great deal for the country in this respect, that they have made it compulsory on the tenant farmer that he should maintain the land he cultivates in good condition. He must apply sufficient manure, and manure of the right quality. If he does not do that he will not only be fined, but he will be dismissed, and therefore to-day the land of England is in as good condition as ever it was, notwithstanding the heavy crops that have been raised from it.

But as regards the majority of the rent receivers in India, they pay but little attention, a great many of them no attention at all, to this question of maintaining the fertility of the soil, and therefore in that regard they are a useless lot. As a result of

recent legislation the Indian people are now given a greater voice in the management of their affairs than they had ten years ago. It may be that with the assistance of these new Indian Councils the Government will pluck up courage to put an income tax upon the rent receivers. But one thing is certain: that the Government must not expend great sums of money in increasing the fertility of the soil, and then give away the extra produce to rent receivers who do nothing to earn the rent. The problem no doubt is difficult to solve, because if the cultivator of the soil makes a good income by his cultivation, it may be he might like to retire from hard work and sub-let his holding to someone else who has no land, and then he, the retiring cultivator, can live upon the rent that he gets from his sub-lessee. So that if landowners are abolished to-day, they may be re-established to-morrow. Now, it is not the object of this book to enter upon political problems which may excite great controversies, and therefore I do not propose to make any suggestions under this heading of the division of the extra wealth that may be obtained by the improvements which I suggest. I merely state the problem and leave it to those who can give their lives to the question to work out the best solution.

Of this I am certain, that if the total wealth of the country, that is to say the total production of the soil is increased, then all the cultivators and all the labourers, whether they have land or whether they are landless, will practically to a great extent

share in the prosperity, and in my opinion before we quarrel with each other about the division of the wealth it would be well to have something to divide; before we quarrel with each other about the government of the country, it would be well to have a country that is worth governing. Now, if we have a people that are well fed, sufficiently clothed and well housed, then we have a country that any man might be proud to govern, then we can consider the problems of autocratic, aristocratic and democratic government. But whatever may be the form of government which the Indian people eventually adopt, there is one thing they will learn, and that is that all government is bad, it is in its nature and essence bad. What we have to look forward to, what we hope for, is that some day there will be no government. I do not mean that there will be no directors and no advisors, but that there will be no compulsion. That people will do right because it is right. So long as compulsion exists, government must be bad. The only thing that can be said in favour of any government is that it is not so bad as the alternative government.

If the Indians govern themselves, we may be quite sure that their government will be bad. The question for them to consider will be: Is the government better that that which preceded it, or is it worse? bearing this rule in mind, that the more governors any nation has the worse, because the more rulers they have the more time they have to interfere with people who are doing work.

If the Indians have any doubt about the nature of a government, let them look at Europe where they have all kinds of government—autocratic, aristocratic, democratic, all of them bad, most of them horribly wicked, taking the hard-earned savings of the people and spending them in making war, a war causing misery and destruction. They will see nations that might enjoy the great blessings which Providence has showered upon them impoverished, desolated and made miserable because their Governments use the power they have acquired for the purposes of destroying each other.

As far as I can make out from my somewhat limited reading, the various Governments that there have been in past times in India all kept up a pretty lively contest with one another. It will be for the people of India eventually to decide whether they like the system of separate Governments that ruled in their country before the British came, the system that still holds in Europe, or whether they prefer the Pax Britannica, with such modifications in the British rule as are suited to more modern conceptions.

I look at the matter not from the point of view of one who has any bias in the matter. Although I am an Englishman, and have been proud of the British Empire from childhood, and willing to give time, trouble and money to increase the honour and glory of that Empire, I do not consider that it is for the benefit of an Englishman that India should be held in subjection by us by force of arms. We as a nation would be richer if we left India alone than

if we held it by military power, and therefore as an Englishman desiring to live a happy and comfortable life, I am in no way biased in desiring to maintain a great Empire in the East.

But this I do think: that looking at India as a whole, there is plenty of scope for the energies of the Indian people in combating the great natural forces of their wonderful country. The torrents that rush from the mountains have to be controlled, the floods and droughts have to be dealt with, life during excessive heat has to be made tolerable, life during relaxing seasons of heat and moisture has to be maintained in vigour, wild animals have to be controlled, including under that head the mosquitoes and other insects which cause or carry disease. In a country like India, where from 70 per cent. up to 84 per cent. of the deaths are due to fevers and other preventable causes, there is plenty of work to be done by those who desire to give themselves to the public service.

CHAPTER XI

Preventable diseases in India—Cholera due to defective water supply—Plague due to insanitary huts—Small-pox due to insanitary conditions and starvation—Vaccination useless—Dysentery, various kinds of unhealthy conditions—"Fevers"; malaria killed 11,000,000 people in 1918—Kills on an average 4,000,000 a year or more—"Fevers" debilitate the entire population in malarious districts—Dr. Sir Ronald Ross—Mosquito transmits malaria—Panama Canal made healthy by destruction of mosquitoes—Ross's teaching successfully adopted in other places—Example near Madras—Quinine a failure—If Indian Government gave the necessary orders to staff of engineers, malaria would be greatly reduced, perhaps abolished—Draining of swamps, ponds, excavations—Eastern Bengal free from malaria because of floods bringing manurial silt, and people in consequence well fed—Western Bengal, in parts where strong river embankments made to protect the railways, prevent flooding, and consequent enrichment of soil by flooding; malaria prevails to a serious extent—Mosquitoes prevented on some Malay rubber estates—Mosquitoes object to muddy water—Government should order the engineers to stop this malaria, and supply them with the requisite funds, or else the Government should resign.

EVERYBODY who has known anything of India has known that there were many parts of India where it was difficult for an Englishman to remain for long in good health, and that an Englishman holding office in India would like to come home once in three years in order that he might re-establish his health. But everybody has not realised that the conditions which are dangerous to the health of an Englishman

are equally dangerous to the health of an Indian; in fact, the Englishman is able to maintain his health better than the Indian—he has more money, he lives in a better house, he eats better food, has plenty of servants, and finds the best accommodation wherever he goes, and with great care and a good constitution may live a long and useful life in that country. He may do that at a time and in a locality where the natives are dying like flies from the illness that appears in the vital statistics under the name of "fevers."

In the year 1918 the death-rate in India was over 62 per 1,000, whereas the same year in the United Kingdom the death-rate was rather over 17 per 1,000. Both death-rates were about the average. In 1913 the death-rate in India was nearly 29 per 1,000, and in the United Kingdom it was a little over 14 per 1,000. In India in the year 1918 the deaths from cholera, small-pox, plague, fevers, dysentery, amounted to 12,500,000, the total number of deaths from all causes being rather less than 15,000,000, out of a population of about 250,000,000. Of these deaths rather over 11,000,000 appear under the heading of "fevers." Of course, this was an extraordinary fatal year; there were famine conditions existing, and under famine conditions disease makes short work of the people. In the year 1916 the deaths were less than half—just under 7,000,000. This included rather over 4,000,000 due to the diseases put under the heading of "fevers." The worst feature of these diseases is not that they kill so

many people, though that is bad enough, but that they lower the physique of the survivors who live in malarious districts, and make them weak and unable to work; and when they are not able to work hard, they cannot earn enough food to eat, and that makes them weaker still, and consequently a prey to disease of every kind. Consequently it makes their lives comparatively miserable and useless.

I propose to deal with these diseases very briefly. Cholera is always in India. Taking the ten years ending 1919, the number of deaths in a year varied from 280,000 up to 578,000. Cholera is caused through drinking impure water. In the dry weather the inhabitants often move from their regular huts and camp on the bed of a dry river and get water from holes dug in the sand. There are no sanitary arrangements, and human excreta is all about. Consequently the water gets polluted, and the result is cholera. I was told by an English engineer in charge of an important province that he could stop cholera in any district whenever he liked by putting up a water-works by which the inhabitants could have a supply of pure water all through the dry season. I asked him why he didn't stop all the cholera in the province. He said it was simply a question of money. The Indian Government would not spend more money on these works than it had to spare in any particular year. If he was to stop cholera over the whole country he would have to borrow money for that purpose.

This contrasts strangely with the method pursued

in England, where the local authorities are compelled by law to borrow money for the purpose of making water-works, and where enormous sums of money would be spent immediately if it was known that cholera would come if proper water-works were not made. In England we have no cholera simply because we have water-works all over the country.

During the last ten years in India the deaths per annum from small-pox varied from 51,000 up to 136,000. Small-pox is simply a case of want of sanitation or want of food. Where the people are well fed and where the sanitary arrangements are sound, there is little or no small-pox. India is perhaps the best vaccinated country in the world. The number of vaccinations paid for by the Government exceeds the number of births, but it has long been known to medical authorities in India that vaccination is no use for stopping small-pox. Nevertheless they continue to vaccinate because it is cheaper to pay about £150,000 a year for vaccinating babies than to establish sanitation, and in the face of the enormous death-rate from fevers, the death of 80,000 or so from small-pox, perhaps, is not considered very important. In the last ten years the annual deaths from plague have varied from 74,000 up to 743,000. This again is simply a case of sanitation and food supply. In many districts the people live in huts with mud floors, and these floors get fouled with human excreta, and as a result plague appears sometimes. The matter was carefully investigated by the most eminent man we have in the study of

epidemic diseases, Dr. Charles Creighton. He went to India when the plague was at its height, and he found that in the British quarters of a city, where all the sanitary arrangements were good, there was no plague, but on the other side of the river, where the sanitary arrangements were bad, the plague was very severe. The only way to abolish plague is to pull down the insanitary huts and build clean huts, and enforce sanitary arrangements, and give the people enough food. From dysentery and diarrhœa the deaths per annum have varied from 264,000 up to 291,000. These deaths, of course, may be due to many causes, chiefly insanitary arrangements and defective feeding. The way of preventing or reducing the amount of these four diseases that I have mentioned is well known to engineers who have given attention to sanitary matters. It is simply a question of capital outlay and annual expense, and if health is worth having it is very cheap at the price.

Now we come to the great disease, the amount of which throws all others into the shadow, that which appears in the Indian statistics as "fevers." In the ten years ending 1919, the annual deaths from "fevers" varied from just under 4,000,000 up to a little over 11,000,000. Leaving out the year 1918, the nine years' average was rather over 4,000,000 a year. Now, it is these fevers that are the enemy of the Englishman and of everybody else. It is these "fevers" that the doctors do not know how to cure and which may puzzle the sanitarian. It

is not possible for anybody to say all at once how to abolish these "fevers." The problem has been studied by many. There are medical men in India appointed by the Government specially to study the problem, who have devoted their lives to the consideration of it. No doubt many engineers living in India have considered it also, and so have ordinary citizens, both English and Indian.

In dealing with malaria one has to take special note of the discoveries of Dr. Ross, now Sir Ronald Ross. In 1892 he was in India and made a special study of the malaria question, and in 1898 he had discovered that a certain kind of mosquito would carry malaria from a person who was ill with malaria to another person, and infect this second person with the ailment. This was an epoch-making discovery, and it has led to the reduction of malaria in some parts of the world. For instance, the celebrated engineer, Lesseps, tried to make the Panama Canal, but the malaria was too strong for him. The superintending engineers could not live on the spot, and only occasionally visited the place. Workmen engaged died very rapidly, so that slow progress only was made. The work had to be given up, and the French engineer and the shareholders who subscribed their money were beaten by the malarial mosquito. When the Americans took in hand the construction of this canal, the director of their operations, working on the knowledge obtained by Sir Ronald Ross, succeeded in clearing the district of mosquitoes, at any rate of that kind which carries

malaria. He made the place quite healthy, so that the work was able to proceed, and was brought to a successful conclusion. In a great many other places the teachings of Ross have been applied, and districts which were almost uninhabitable on account of malaria are now quite healthy. According to Ross, one may live in a malarial district without catching the disease if one is always sheltered from the *Anopheles* mosquito. One has to sleep in a bed enclosed by net curtains which will let in the air but keep out the mosquito; one has to live in a house where all the doors and windows are closed with netting which prevents the mosquito flying in; and when one walks out in a district where these mosquitoes are to be found, one must cover up all the skin of one's face, neck, etc., and one's hands with gloves to prevent the mosquito from biting. In districts where malaria abounds it has been found that people who take sufficient precautions can escape the disease.

Some eight or ten miles north of the town of Madras there is a little seaside town which has been regarded as a health resort. However, some ten or twelve years ago it became unhealthy, and the visitors there got malaria, and enquiry showed the cause. Some trees had been planted so as to make an avenue, and round each of these trees a little pool of water was arranged so as to help them to grow. The mosquitoes found these pools of water good breeding-places, and so there were soon plenty of mosquitoes, and soon after that there was plenty

of malaria. It is not thought that the mosquito makes the malaria, only that it carries it. There happened to be in the neighbourhood a number of labourers who were engaged in making a new railway, and these labourers had come from a distance, from a part of the country where there was a great deal of malaria, and it was thought that the mosquitoes had bitten some of these labourers and then carried the poison to other people. The malaria was approaching the town of Madras when this discovery was made. Hastily the pools of water were filled up and the mosquitoes were destroyed, and in a few years' time this seaside place became once again a health resort. This is enough to show the difficulty of dealing with malaria: every little puddle may be a breeding-place for mosquitoes.

If a drinking-fountain is made, a little water splashing on the ground may make a puddle and be a breeding-place for mosquitoes. If these mosquitoes are to be abolished from any locality every puddle must be filled up, every little broken pot lying about which might hold a tablespoonful of water must be buried. Every stream must have its banks made straight and smooth so that there shall not be little corners where the mosquito may breed. Every tank of water must also have its sides made straight and clean and smooth, and where necessary the surface of the water must be covered with petroleum, of which a very thin layer will drive away the mosquitoes. It is easy to see what a big job is

suggested when it is proposed to remove all the possible breeding-places in a country like India.

Of course, in the hot, dry season there will be no puddles; the only places where water can be found will be in rivers, canals, lakes and tanks. As a general rule, however, the mosquitoes do not travel very far, and if your house is 200 yards away from a breeding-place you are not likely to be much troubled with mosquitoes, although they may come. But during the rainy season there must be any amount of puddles and little streams and places where mosquitoes could breed, and one can well understand that the authorities consider that it is too great an undertaking for them to carry out the advice of Sir Ronald Ross, and so from three to five million people in India die of this malaria every year. It is not like cholera, a disease that takes you one day and kills you the next or within a week; it is a disease that you may have for years intermittently, but it reduces your vigour. Probably to one person who dies in a year there are ten who are ill, perhaps a much larger number.

There is no medicine known that will prevent it or cure it. I say this notwithstanding the fact that it is believed by many people that quinine is both a preventative and a cure for the disease, but I believe the greater part of the people of India do not consider that quinine will cure them or prevent it. I met two English medical men in India who gave their lives to the study of the question. One of them said that he took small doses of quinine

constantly in order that he might not take malaria. The other one said that he went about into all sorts of malarial places, but he never took quinine until he had been attacked by the disease, and then he took some quinine and that cured him at once. That the first doctor avoided malaria I quite believe, that the second one got cured of it I also believe, but it is difficult to say what part the quinine played either in the prevention or the cure. I met another Englishman, a fine, strong man, who had caught malaria and was attended by the best medical man he could get, and he told me that he understood that he should never be quite well until he had been home to England and had a long holiday in that climate. A friend of mine who gave very great attention to medical questions and managed to keep himself in first-class health until he was over eighty years of age, and who spent thirty years in India, a great part of the time in charge of a considerable number of troops, told me that he considered "quinine was one of the greatest curses from which the world suffered." However it may be with quinine, there is no doubt that if sufficient care is taken malaria can be greatly reduced, and probably it can be abolished from India if we only take the trouble and are willing to incur the expense.

What a magnificent country India would be if only this malaria was abolished, and I am quite certain of this, that if instructions were given to the engineers in the employ of the British Government in India to abolish malaria, and they were

allowed the requisite sums of money, they would soon make a very great change. It is not as if India was a thinly populated country. There is an enormous population, and many of the people are only too glad to have some very poorly paid employment. If properly directed, the puddles could be filled up, the broken pots and tins removed, the banks of rivers, streams, canals and tanks made straight, and petroleum could be put upon the water where necessary. There are a great many swamps and ponds which serve no good purpose. They are not required for the water supply; they do not supply fish to any people, nor serve any other purpose of use to the community. And yet these swamps and ponds may breed a great many mosquitoes. If the swamps and ponds are far away from human habitation, they may to a great extent be neglected as not likely to do any harm, but, on the other hand, it has been noticed for thousands of years that malaria is found in swampy districts.

In the construction of a railway it is frequently necessary to make an embankment, and the material for the embankment is often got by the excavation of ground beside the railway. These excavations become full of water, and may make capital breeding-places for mosquitoes, and therefore they should be drained or filled up. It is very easy, of course, to say that, but where is the material to fill them up? They were made in order to get the material to make the railway embankment. Nevertheless, a little labour may cut down the steep banks into gentle slopes,

and so provide material to fill up the hole to a height from which is can be drained by a trench cut from a lower level. If there is no lower level and no material to fill up the hole, then drainage must be effected as in England and Holland by pumps worked by windmills or other power, such as steam-engines, oil-engines, or hydro-electric. The same way in dealing with natural swamps: they may be drained by means of trenches.

In some countries, following the advice of Dr. Ross, malaria has been eradicated by hunting the mosquitoes and so driving them out of the district. Where there is a large population willing to work this is quite possible. In places where it is impossible to remove the mosquitoes, or where the work is in progress, it might be possible to reduce the amount of disease by the supply of mosquito nets. No doubt the greater part of the labouring population are too poor to buy these nets, and they might be supplied at the expense of the Government.

But this treatise was not written in order to show in detail exactly how this malaria is to be stamped out. I only venture to point out some ways in which this work might be begun, probably with great effect, and it is only necessary for the rulers of India to give their minds to the consideration of such a subject. If only they could give their minds to these questions which concern the lives and health and well-being of the people instead of wasting their energies on other matters of no importance, India might be made a sanatorium—at any rate I have

read that the banks of the Panama Canal were made into a place that could be visited as a sanatorium in consequence of the successful efforts of the engineer in charge to abolish malaria, and the malaria of the Panama Canal was the deadliest kind the world has ever known.

One of the great causes of the deadliness of malaria in India is the poverty of the people. There is no doubt that the enormous death-rate in the year 1918 was due to the starvation of the people due to a deficiency in the harvest. If the improvements in agriculture which I have suggested were made and the crops were greatly increased—if they were increased by only 10 per cent. it would be enough to give the people plenty of food, but I am quite certain that the crops could be increased by 50 per cent. very soon by the methods which I have suggested—then the people will be well fed, and as a consequence they will be able to resist malaria much better than they do now.

One of the learned medical men who was employed by the Government to investigate the matter, and who has given a great many years to the study of the question, told me that in Eastern Bengal, where the land was flooded every year by the Ganges and the Brahmaputra, and where the floods deposited a silt which manured the land, and as a result the people got good crops and plenty of food, there was practically no malaria, which meant that the people were strong and were able to resist the attack. Of course, if there is no malaria in a country, there

is no reservoir of poison from which the mosquito can carry it to other people. I am aware that there are difficulties in accepting every statement that is made to one, but the fact remains that this experienced medical man considered that in that part of Bengal there was very little malaria indeed, and in another part of Bengal, where the river did not flood the country, many of the districts suffered severely, and some places were depopulated in consequence of the malaria, which so reduced the strength of the cultivators that they were unable to cultivate the soil. A man who has not got to work hard may go on having malaria for many years and survive, but if he has got to work hard, then comes the difficulty: he cannot work hard, and therefore he cannot earn his living, and so the combination of starvation and malaria hastens his end.

An old Indian gentleman told me in December 1914: "When I was a boy I lived in the country below Calcutta; food was plentiful and cheap, we had plenty of milk, and fish in abundance in the river. Now food is dear, milk is scarce, there are no fish, malaria is rampant, the people are dying." There is truth in this statement, and it can be explained. The following explanation is what I gathered in conversations with Englishmen of high position stationed in Calcutta:—

The present scarcity of milk is due to the increase of population causing a demand for land for cultivation, and in this way reducing the area available for cattle grazing.

This demand for land causes an increase of rent charged

by the landowners, thus forcing the tenants to sell their rice in order to get money to pay their rent and so diminishing the supply of food available for the cultivators. The increase in the population of the towns and consequent increased demand for food causes the price to rise.

The want of manure prevents the cultivators from raising larger crops per acre, and so coping with the increased demand for food to supply both men and cattle in abundance.

Numerous river channels which sixty years ago abounded with fish are now blocked with silt and vegetation.

The construction of railways on a low level involved the maintenance of high and strong river embankments to protect the railways from destruction by floods, and as a result the annual flooding of the plain was prevented. When the river spread over the plain on the flooded land it had such a very slight velocity that it could not carry the mud, which was therefore deposited, enriching the soil. The clear water then ran off by the river channels, keeping these clear and fit for the fish which abounded. The soil was thus impoverished, owing to the embankments which prevented the floods which enriched and kept the escape water channels clear. The scarcity and high price of food of all kinds weakened the village people, causing them to yield to the infection of malaria, which in consequence increased in amount and virulence. The demand for land for grain growing also makes it difficult to make or maintain plantations where trees could be grown to supply wood for fuel (and shelter for cattle), consequently the cowdung is used for fuel instead of being used for manure.

A great deal of experience has been gained as to how to exterminate mosquitoes on the "india-rubber" plantations in the Malay Peninsula. On some estates the utmost care has been taken to close or remove every possible place where the mosquitoes might breed. The hoof-marks of an ox might form a place which would hold water; a little trickling rivulet of pure water is a place where they like to breed; this

trickling rivulet must either be culverted, or its banks must be cut straight so that the water shall run clear through without little pools in which the mosquitoes can lay their eggs. But when sufficient care is taken, then the result is that there is little or no malaria on that estate. It is remarkable that the mosquitoes do not lay their eggs in muddy water. A great muddy marsh, lake, or canal is comparatively free from mosquitoes. Also, in dealing with the great rivers of India, one has not so much to fear them because they are nearly always muddy.

It is to be hoped that the Indian Government will take the matter up. Why should the population be weakened and degraded? Why should the British residents be continually invalided? Those in authority have only got to give the requisite orders to their clever engineers, and this cause of disease and death and decline and misery will be removed. It may demand an outlay of capital, but that would be soon repaid. If the British Government cannot command that capital, then the Government had better resign.

CHAPTER XII

Population question—Table showing population and its increase every ten years—Early marriage and tendency to rapid increase—Tendency checked by fevers and other diseases—Agricultural population cannot increase so rapidly as a manufacturing population—The leaders and teachers must impress on the people the need of reducing rate of increase—The alternative is disease, misery, and famine—Room in India for increase of numbers, but the increase must not exceed about one million a year—Strong comments—Table VIII.

WE have now to consider what is called the population question. The population of India has been increasing rapidly in the last fifty years. The following Table VIII has been prepared from the *Imperial Gazetteer of India*, published 1909, vol. i, page 459, and from the *Statistical Abstract Relating to British India*, published in 1921 (c.m.d. 1425), and from the Supplement to the *Gazette of India*, April 9, 1921, giving the census taken March 18, 1921.

Table No. VIII shows that the population of India, including the Native States, according to the census returns, was in 1872 about 206,000,000 (it is thought that the census, and particularly that of the Native States, was incomplete), in 1881 about 254,000,000, in 1891 about 287,000,000, in 1901 about 294,000,000, for 1911 about 315,000,000, and

TABLE VIII.

The Population of India. The figures are only approximate, and are abstracted from the censsus for each year named.

Year.	All India.	Provinces.	States and Agencies.	Population Enumerated for the First Time.		Increase of Population after Deducting that Enumerated for the First Time.		Percentage of Increase after Deducting Population Enumerated for the First Time.	
				Provinces.	States.	Provinces.	States.	Provinces.	States.
1872	206,000,000 [1]	185,000,000 [1]	21,000,000 [1]	—	—	—	—	—	—
1881	254,000,000	199,000,000	55,000,000	—	33,000,000	14,000,000	1,000,000	8	5
1891	287,000,000	221,000,000	66,000,000	3,000,000	2,600,000	19,000,000	8,000,000	9½	14
1901	294,000,000	232,000,000	63,000,000	2,000,000	500,000	9,000,000	deduct 3,000,000	4	decrease 4½
1911	315,000,000	244,000,000	70,000,000	say 1,000,000 [2]	say 1,000,000 [2]	11,000,000	7,000,000	5	10
1921	319,000,000	247,000,000	72,000,000	—	—	3,000,000	1,400,000	1	1

The comparatively slow rate of increase of population during the last decade is due to the epidemic of "fevers" in 1918, probably caused by partial famine.

[1] First census in year 1872. The 1872 figures are probably underestimated.
[2] Figures not in abstract.

for 1921 about 319,000,000. From 287,000,000 in 1891 to 315,000,000 in 1911 the population increased about 28,000,000 in twenty years—that is, just 10 per cent., or at the rate of 5 per cent. in ten years. If we take only the population immediately governed by the British, the population in 1891 was 221,000,000, in 1911 244,000,000, so that there is an increase of 23,000,000 in twenty years; this, again, is just about 10 per cent., or 5 per cent. in ten years. In the ten years ending 1921 the increase of population was comparatively small, because of the enormous death-rate, in 1918 and 1919, from fevers, probably due to partial famine, and also the consequent diminution of the birth-rate.

The question is, Is it desirable that the population depending upon agriculture should continue to increase at the average rate of the last forty years? Some people think that the population of India will never be well fed, well housed, well clothed, so long as it continues its efforts to increase at a rapid rate. How that may be I cannot say, but it is to be hoped that there will come some change in their habits. I have been told that it was not always the case that the women were married so young as now, twelve or fourteen—that it began a long time ago. There are many Indians who are trying to set the fashion of later marriages, and it would appear to a European that it would be a good thing if marriages could be put off to the age of twenty to twenty-five.

If as a result of later marriage there were fewer

children, it would certainly tend to make life easier and tend to assist the accumulation of property, and tend to give the people better food, better clothing, better housing and more amusement, so as to make life better worth living. It has been found in parts of Europe, such as England and France, that as the wealth of the people increases the birth-rate diminishes. So much has that been the case in France that now there is hardly any increase of population, and in England the rate of increase of population is getting slower. In England, sanitation has so reduced the death-rate that it has almost got down to the minimum possible, so that further reduction in the birth-rate will greatly reduce the rate of increase of population.

In India the death-rate is still very high. If the improvements that I have suggested are made, the death-rate will be brought down, and if it should be reduced one-half its present rate, and if the birth-rate should remain the same, the population of the British Provinces would increase 4,000,000 a year more than its present increase, or, say, 5,000,000 every year, or 50,000,000 in ten years, requiring 50,000,000 more acres of land to cultivate. This would cause an intense struggle. It is obvious that the time has now arrived when the leaders and teachers of the people must unite to discourage the present fashion of excessively early marriage, and must teach both women and men that it is not necessary for all of them to marry at any age, that young people must consider, before they marry, how they

are going to get the necessaries, comforts and reasonable pleasures of life for themselves and their children. The alternative to the limitation of marriages and children is continual hardship, desperate poverty, debilitating and fatal diseases rampant, and every ten years a great desolating famine. Wars, unless accompanied by famine and disease, would not suffice to check the increase of population.

No doubt the Indian statesmen will consider that question, and consider how far it is their duty to try and influence the habits and customs of the people with regard to marriage, otherwise it certainly may happen that in the course of a generation the population of India may become too great. But at the present time there is a great deal of land now uncultivated which might be cultivated, and if the production per acre is increased in the way I have suggested, the land will give food enough for a greatly increased population.

"It is the pace that kills." India can carry a greatly increased population with comfort and happiness for all if the rate of increase of population is less rapid than the increase of food, clothing, housing, and other forms of wealth; but if the order is reversed and the numbers to be fed and clothed and housed increase faster than the food, clothing and housing, then the result will be starvation, disease, misery.

One reason why the Australians refuse admittance to Indians as settlers is because they have noticed the terrible poverty of the Indians, partly resulting

from the tendency to a too rapid increase of population, and they don't wish to have their standard of life reduced to that of the Bengalee labourer.

A people who depend on agriculture cannot increase in numbers in a country already densely populated at the rate that may be quite practicable for a people that mainly depends on manufactures with which they supply the world.

Land is not elastic. As the people increase in numbers, agricultural production can only increase by intensive cultivation or the occupation of inferior land, or new great irrigation and reclamation works. These things can be done, but they require time. But factories of all kinds require only a negligible quantity of land, so that, so long as foreign markets can be found, a manufacturing population may increase at a rapid rate, and increase in individual wealth and comfort and enjoyment at the same time until the market limit is reached, and then the increase of population must stop, as it has already done in France.

In the last forty years the population of the provinces of British India has increased 48,000,000, and except for the rampaging "fevers" it would have increased 200,000,000, but that was impossible with the methods of food production practised by the agriculturalists.

IF THE PEOPLE OF INDIA WISH TO BE HEALTHY, WEALTHY, COMFORTABLE AND HAPPY, THEY WILL AT ONCE CARRY OUT ALL THE WELL-KNOWN SANITARY MEASURES WHICH I HAVE MENTIONED. THEY WILL

ADOPT IMMEDIATELY A MORE INTENSIVE SYSTEM OF AGRICULTURE. THEY WILL PROCEED WITHOUT DELAY WITH AFFORESTATION, WITH GREAT IRRIGATION, DRAINAGE AND LAND RECLAMATION WORKS. THEY WILL GET MORE HYDRO-ELECTRIC POWER STATIONS. AND AT THE SAME TIME THEY WILL SO ORGANISE THEIR FAMILY LIFE THAT THE POPULATION DOES NOT TEND TO INCREASE MORE THAN, SAY, ONE MILLION A YEAR, SO THAT IT SHALL NOT BE NECESSARY FOR DEATH IN THE SHAPE OF "FEVERS" AND OTHER HORRIBLE DISEASES TO SLAUGHTER THEM.

The history of India in the last fifty years is the history of a people possessed of great natural advantages, of which they have failed to make a satisfactory use. I set out these advantages as follows :—

(1) A great country, beautiful, fertile, a climate which in average years permits the growth of food and all other necessary and useful things in great abundance, so that ample provision may be made for years when the rainfall is deficient; a climate which is never very cold in the daytime, where the heat is sometimes excessive for some months over large areas, but this heat can be mitigated, and endured without injury to the health of the natives. In every part the climate is delightful for some months in the year, and in some parts for most of the year.

(2) There is a stable Government which administers the laws on the average with as much justice as is found in any other country.

(3) There is peace over all the land (except insignificant frontier fights)—that is, over a larger area and larger population than has ever known such peace before.

(4) The people are strong and capable in body and mind, highly moral and religious, trying to do their duty by themselves and by their neighbours.

Their cultivators of the soil, artificers, mechanics, clerks, accountants, lawyers, preachers, teachers, writers, statesmen, merchants, manufacturers, sailors, are making necessary allowances for differences in climate, comparable to those of any other nation.

(5) There is great mineral wealth, including oil and coal, and there is also hydraulic power far beyond any possible need.

(6) This great country and this great people, with its enormous well-ordered population, sufficient for all the work it has to do, could, if wisely guided, support double its present numbers in health, plenty and pleasure.

These are the natural advantages!

But what is the present situation? And what has it been for the last fifty years?

This: The people have engaged in a desperate, hopeless, foolish, futile, ignorant, careless struggle to increase their numbers at the rate of about 5,000,000 a year, or 250,000,000 in fifty years, and Nature, outraged by this absurd assault, has struck

them down and killed 4,000,000 of them every year on the average.

There is no insuperable natural or physiological reason why the people should breed at this rate. In some parts of the country there is prudence in this regard. Among the cultivated classes there is the foresight and care that might be expected.

This child marriage, this marriage of nearly all the women among the poorer classes, this too rapid production of children, is a matter of fashion.

Fashions come and grow.

They remain and decay, and then go.

This fashion must go—the sooner the better.

CHAPTER XIII

Food supply, total weight of food produced—About 9 lb. per family of five per day—Fish and meat to be added, cattle consumption to be deducted—Cattle eat a large part of the food of the poor people—Food production at present insufficient—Increase of food production necessary for the health of the people, and for the well-being of the cattle.

In Chapter IX, I have shown the money value of the production of the soil. In Table IV, page 104, I have shown the weight of the food production. In considering whether or not the produce of the soil is sufficient for the people, it is not, of course, the money value of the crops, but the actual weight of the food, that must be considered. Now, if we take the actual weight of all the grain crops in the year 1919-20 (Table IV) and divide it by the population, we find that if it was equally divided there is just enough food for the people to live on—that is to say, there is enough to give 2 lb. a day of grain to every man, 1½ lb. to every woman, and 1¼ lb. of grain to every child and old person, with 1¾ lb. to spare in every family of five persons. I have taken the weight of all

the grain and rice, 70,804,000 tons, and adding 2,500,000 tons for fruit and vegetables, and 3,000,000 tons for sugar, I get a total weight of 76,304,000 tons. Deducting from this, 3,000,000 tons for exports, it leaves 73,304,000 tons for consumption. This divided by 247,000,000 people in that part of India which is directly governed by the British, gives a weight of 665 lb. for each person in a year, $1\frac{4}{5}$ lb. (1·82 lb.) per head per diem. If we take a family consisting of five persons, that would give 9 lb. for the family. These five persons we will consider as one working man, one working woman, one old person and two children, and the allowance would be, one working man 2 lb., one working woman $1\frac{1}{2}$ lb., $1\frac{1}{4}$ lb. per head for the old person and two children, leaving $1\frac{3}{4}$ lb. over for domestic animals. To this amount must be added some milk and flesh from the cattle, sheep, goats, etc., also eggs, poultry, and fish, perhaps also some ground-nuts, but on the OTHER HAND THERE MUST BE DEDUCTED FROM THESE FIGURES THE AMOUNT OF GRAIN CONSUMED BY THE CATTLE, of which there are nearly as many as human beings—that is to say, about 209,000,000 altogether, large and small, equivalent to about 170,000,000 oxen. This is without counting poultry, etc. There can be no doubt that these animals require some richer food additional to the fodder crops, to grass, leaves, straw, corn-stalks, roots, cotton seeds, rape seeds, husks, chaff, etc.

There can be little doubt that in addition they

get a great deal of that grain, which I have calculated as being sufficient for the human population, and it is probable that it is the need of giving this grain to the cattle which is one of the chief causes of the insufficient supplies of food to the working population. The richer people, who own horses and who desire to get a good supply of milk from their cows and good work from their oxen, will buy corn for those purposes, thus raising the price and diminishing the supply of corn for their poorer neighbours.

When we recollect that an ox requires from 15 to 30 lb. of food a day, we soon realise that the animals require a great deal more food than the human beings, and we must also realise that in a country like the northern part of India, where over large areas there is no rainfall for eight or nine months in the year, it becomes apparent that the grazing-ground for the cattle must be dried up for more than half the year, therefore in those months there is no green grass available for the cattle. If one calculates the weight of straw, one finds that it is not sufficient by a long way. There are no statistics to show the weight of grass, and the acreage under fodder crops is not much more than 8,000,000 out of a total acreage under crops of 271,000,000. Some proportion of grain, bran or meal is generally set down as part of the daily ration of a cow or a working ox or horse, so I am forced to the conclusion that in the densely populated parts of the Ganges Valley and the Punjab, and elsewhere the cattle eat a

considerable proportion of the grain which is required for human consumption, and for that reason many of the poorer people are half starved.

Therefore an increase in the production of grain is absolutely necessary for the health of the people. In estimating the weight of the grain crops I have taken the Government statistics. Writers of great experience have said that these Government statistics give weights in excess of the actual weights. Upon that question I can express no opinion. One knows very well that the cultivators who have to pay rent and revenue tax do not wish to give the impression that their crops are large, and they will try all they can to under-state the amount of their crops. On the other hand, we have the undeniable fact that whenever there is a shortage of rain, and consequently a shortage in the crops, there comes a famine and millions of the people die. They died in the year 1900, they died in the year 1918 like flies. Those two great facts satisfy me that the production as given in the Government statistics is not under-stated. Considering the small average yields of grain per acre at the present time, it could not be said that, even if those yields were doubled, there was any attempt to work the soil too hard, but on the other hand if the production of the soil was increased only 20 per cent. it would add enormously to the health and comfort of the people. If the production was increased 50 per cent., it would add very greatly to the health and well-being and efficiency of the cattle, and that again would

help the people, for whom the labour of the cattle is so essential and the milk so valuable, to say nothing of the supply of meat to those whose principles and pockets will allow them to eat flesh food.

CHAPTER XIV

Supply to India of artificial manures—Price of manures—Indian cultivator refuses to pay price because he is so poor—Artificial manures essential, more phosphoric acid necessary—Government must pay for these manures and take repayment out of the increased crop—Superphosphate can be made in India from imported mineral phosphate and imported sulphur—Mineral potash salts also required—Mineral nitrates also required—India can make nitrolin from the air—Great profit will result—No great outlay of capital necessary—The expenditure on manures would be very much less than the cost of an army to keep in subjection a discontented people—Delay in business fatal to success—There must be no delay here.

WHEN the use of artificial manures for India is discussed, it is usual to say that they would be very good, but that the price is prohibitive. That means that the price is too much for the ordinary cultivator to pay. Now, the price that a man will pay for any good thing that will improve his future revenue and welfare depends upon his outlook. Most people do not look very far ahead. Now, in the United Kingdom, if a poor man should borrow £1, he would think it a very moderate rate of interest to be asked to pay 1s. a week for the use of that £1. But that is at the rate of 260 per cent. per annum, which is, of course, an entirely prohibitive rate for an ordinary business man. In the same way with the Indian cultivator. When he is asked to buy wood for fuel

in order that he may put his manure into the ground he objects to pay the price. He does not look very far ahead. He admits that it would improve the value of his crops more than the cost of the fuel, but, on the other hand, suppose there came a drought, suppose the monsoon was to fail and he had no crops at all, then what return would he get for the manure which he had put into the ground? He would get none at all that season. And yet he knows that on the average of five years it would pay him very well to manure the ground, but he does not do so because his present necessities are so pressing. The man who is considering whether or not he will have sufficient food on which to live for the next three months is not prepared to make an outlay for which he may get no return for the next fifteen months.

And then again it must be borne in mind that an outlay upon artificial manure may be wasted unless the manure is selected and applied under scientific advice. To ask the poor cultivator to pay a chemist to analyse his soil would, of course, be ridiculous. He never handled as much as a chemist's fee at one time in the whole course of his life. If, for instance, one was applying to the land what is called a complete manure, such as guano, which contains phosphorus, potash and nitrogen, then one knows that it must do good; but if the manure only puts in one of those items, then one does not know that it will do good. And if we put in phosphoric acid when there was not sufficient limestone in the ground to absorb that acid, we might do harm to

the ground ; and it is quite possible for people to put in potash when there is already sufficient in the land, and that might do harm to the next succeeding crop. And the same with nitrogen ; that might promote a great vegetation, but perhaps not give the grain what was wanted, and the application of nitrogen has an exhausting effect upon the soil. So that to apply artificial manures except under good advice, is very speculative. A large farmer would make experimental trials on what would be for him small plots, and if his experiments were a failure or partial failure it would not be a serious loss for him. But for the Indian cultivator to lay out £1 in artificial manure would be a very serious matter to him, and therefore in the majority of cases he will not attempt it. It is therefore necessary that those who have capital should supply the cultivator with the artificial manure upon terms that if the result is satisfactory, the loan should be repaid with interest out of the additional profit that he gains by the use of the manure. Of course, even on these terms it would be difficult to get the cultivator to consider them unless he was approached by somebody with considerable experience and tact in dealing with Indian cultivators, and was able to show him the results obtained by others. But if the matter was begun in a careful and scientific way there can be no doubt that it would not take very long before the use of these artificial manures became general, and even when, by the supply of suitable fuel, all the cow dung as well as human excreta was supplied

to the land, still the artificial manures would be used in addition to a very great extent.

The next question that arises is how to get these enormous quantities of artificial manure. In a previous chapter (VIII, page 88) I spoke of 7,000,000 tons of superphosphates. Now, of course, the world is not prepared to supply to India that amount of superphosphates all at once, an additional demand for 1,000,000 tons would probably put up the price, and yet it is essential to reduce the price, and there is no doubt that these phosphates—whether superphosphates or tricalcic phosphates were used—could be got at a price much lower than the ordinary market price by a purchaser who was prepared to give large orders year after year. I have made a good many enquiries, and I find that there are large deposits of tricalcic phosphates in Algeria, Tunis, Egypt, in some Pacific Islands, and in the United States of America, where very important deposits are found in South Carolina, Florida and in the State of Idaho. A little calcic-phosphate has been found in the South of India. In the year 1913 the American and Tunisian calcic-phosphate was sold at about 15s. a ton, and I therefore think if the Indian Government gave a large order and arranged for the regular transport in large steam vessels, it could be delivered at an Indian port for a cost not exceeding 30s. a ton. The phosphates in the South of India have been used to some extent with success. The insoluble phosphate rock, if ground up to a fine powder, will supply the ground with the requisite phosphoric acid. It may

take a long time before it is assimilated by the plant. If the Indian Government was ready either to make contracts with suitable capitalists or to find the money itself, it might put up large works for the manufacture of superphosphates, and for that purpose it might buy sulphur either from the United States or from Sicily, or in the alternative it might buy sulphuric acid. Sulphuric acid is largely manufactured in this country and in Europe from sulphur, which is a waste product, as in the case of copper pyrites. Sulphur has been sold free on board ship, both in Sicily and in Texas, at between £4 and £5 a ton, but it is highly probable that if some contractor on behalf of the Indian Government was able to place large and permanent orders, this material might be put on board ship at a much lower price, so as to be delivered in India at a price not exceeding £4 a ton. If this was done, the superphosphate might be made in India at a price not exceeding that previously mentioned of £3 a ton. In the same way with regard to nitrate of soda, it is probably quite possible to make some contracts with the owners of the nitrate works in Chili to supply this material in large quantities at a much lower price than the usual price, also on the understanding that it should only be delivered in India, and not be sold from that country to any other country. The same remarks apply to potash, whether in the form of kainit or any other form. Now that India has got large iron-works, and as a consequence large coke-oven works, sulphate of ammonia is being made at these

coke-oven works, but, of course, only in small quantities at present—that is to say, quantities small in proportion to the enormous demands of India. Basic slag is a valuable manure. It is quite possible that the Indian Government might be able to secure large quantities of basic slag from England and other European countries at a moderate price for large quantities, which the Indian Government would take whenever it could be delivered and could stock it in India, and the Indian Government might set up machinery for grinding the basic slag to the most suitable fineness.

As regards the cost of all this work, I have dealt with it before. Of this I am quite sure, that it will cost the Indian Government much less than keeping a large standing army in order to keep down a discontented people. It must be understood that the people of India are some of the most intelligent people in the world, and quick to appreciate any damages that they suffer or any advantages that they gain. If the Indian Government were to do such an unusual and extraordinary thing as actually to proceed to spend money on manures in order that the patient cultivator might get a good living, might be well fed, well clothed, well housed, for a time at any rate the people would be contented and grateful.

In Chapter VI an estimate was given of the possible cost of railways to reach the forests so that the small wood and underwood might be sent down into the plains to be used as fuel by the cultivator, and also mention was made of the possible outlay that might

be required to convey coal to the neighbourhood of the cultivators in districts where at the present time no railway is near. These two projects would undoubtedly involve a considerable capital outlay, but the other method suggested of supplying fuel to the cultivators, that is of making plantations in the vicinity of their villages, does not involve any large capital outlay, because although in course of years the amount expended on these plantations would amount to a large figure, it would not be a large figure at the beginning. If £1,000,000 was spent in the first year, that would probably be as much as could be wisely spent in that year with the organisation at present ready for the purpose, and as the work proceeded and the wood grew up there would come repayment of the expense by those who used the fuel in substitution for manure, under the scheme suggested by which they should pay the value of part (say half) of the improvement in their crops resulting from the use upon their land of cattle-dung, which now they burn; so that while the payment would not be a charge upon the cultivators, it would repay the outlay on the plantation. There need be no hesitation in beginning this work, which for the last sixty years has been recommended by a great number of eminent men who have visited India or lived there. Also with regard to the supply of artificial manures such as phosphate of lime, that does not involve a large capital outlay, because at the beginning the introduction of these manures will necessarily be slow, and it will have to be done

very carefully. Therefore it would be unwise to spend a large sum in the first year. If £1,000,000 was spent in the first year, that probably would be as much as the present agricultural organisation would enable the Government wisely to spend on these mineral manures, but following upon the increase in crops due to increased fertility would come repayment by the cultivator out of the increased value of his crops, so that the outlay by the Government would be quickly repaid. The second year £2,000,000 might be spent on these mineral manures, the third year £3,000,000, and by that time the organisation for the distribution of these manures would be complete and the distribution of them might become more general and rapid, bearing in mind that this distribution cannot proceed more quickly than the supply will permit, and also bearing in mind that as the planting of trees for fuel proceeds, and consequently the use of cowdung extends, the urgency of the need for great quantities of mineral manures in those parts will be reduced. Therefore there is no excuse for delay on the ground that a large capital outlay is involved which requires careful consideration. If there is delay, it will be because the Government is not inclined to trouble itself to make the necessary arrangements to increase the fertility of the soil.

Every practical manufacturer or producer knows that one great secret of business success is to avoid delay. To delay making a necessary improvement is fatal to business success. Every successful business man studies the situation, and as soon as it is

clear to him that a certain improvement has to be made, he makes it forthwith. The unsuccessful business man delays until it is too late. I would therefore suggest that the Indian Government should proceed at once to arrange for the supply of £1,000,000 worth of artificial manures in the course of the following year, for the expenditure of £1,000,000 a year on plantations to supply fuel to the cultivators; that it should spend £1,000,000 a year on afforestation as distinct from these special plantations for fuel; should spend another £1,000,000 a year on additional branch railways and on roads to facilitate the transport of timber from the existing forests to the places where it is required. This can go steadily on, and the returns will begin to come in in twelve months' time from the beginning, and in two years' time the returns will begin to come rapidly in, and after that, the quicker the Government proceeds with the work the handsomer will be the return that it will get. With regard to the very large schemes of afforestation and of railway constructions that I have suggested, I would suggest that the Government takes expert advice on these points and ascertains really what the cost would be of these various works, but this is not to delay the immediate starting of the smaller works above suggested. This expenditure on work and material, evidently for the immediate good of the people, will have a tendency to give satisfaction to many of the people; it will give profitable employment to great numbers and tend to improve trade.

CHAPTER XV

Hydraulic power—Vast water power in India on account of heavy rainfall on high mountains—Novel hydro-electric works of Messrs. Tata—Hydraulic power from reservoir 60,000 horse-power now being used in Bombay—100 million horse-power might be utilized eventually—The money wasted on military adventures, if laid out on useful works, would make India a wealthy country.

THE success in life of the people of the British Isles is chiefly due to two causes. The first is the magnificent climate, unsurpassed in any country in the world, which conduces to vigour of mind and body and great activity. Second is the possession of great supplies of coal, by the use of which steam engines can be driven, and which gives on the average to each household in the country the service of a power equal to that of five strong horses. Now, the people of India possess a climate which has some advantages and some drawbacks, but undoubtedly great warmth is not conducive to the vigour of mind and body and activity which is possessed by some people in colder climates. Nevertheless in these days of the development of modern science there is no reason why the people of India should not make use of those aids to production and enjoyment which can be obtained from the use of steam-power or of

power derived from other sources. India has great stores of coal which are now being developed and by the use of which powerful steam-engines can be driven and the labour of the people can be supplemented by the energy of this mineral fuel.

In addition to coal-power, India has great water-power. There is an enormous amount of water-power in India which may be utilised. Some of it is now being utilised in the neighbourhood of Bombay as well as in other places; 60,000 horse-power is now being utilised in the mills of Bombay, which is derived from the fall of water on the Western Ghats, the mountains that line the Indian coast from Bombay southwards. If we take the mountains of the Western Ghats and the Himalaya Mountains and some other mountains without counting those of Burmah, we have a length of 3,000 miles of mountains. Those which are in the Himalayas might be written down as having a width of not less than 100 miles upon which there is a heavy rain-fall every year, and they rise up to great altitudes. It is easy to conceive what an enormous power there is in this falling water. One cubic foot of water falling 1,000 feet might generate two horse-power if it fell in one minute. If we assume a rain-fall of 48 inches or 4 feet, and assume that one-half of that rainfall was utilised for power purposes, and take an area of 1 square mile, the following sum shows that we should get by the fall of the water on that 1 square mile down a height of 1,000 feet a power of 500 horse-power, for 10 hours a day for

300 days a year. Four feet of rain divided by 2 equals 2 feet of water available for power production. Each cubic foot weighs 62½ lb.—say 60 lb.; each acre has about 43,000 square feet—say 40,000 square feet; each square mile has 640 acres—say 600 acres; fall 1,000 feet. Each horse-power requires 33,000 foot-lb. of work done in one minute—say 30,000 foot-lb. Each year has, say, 300 working days, of, say, 10 hours each, and each hour has 60 minutes. Then the horse-power from 4 feet of rain one-half available, or say 2 feet of rain is shown by the following sum :— 2 ft. × 60 lb. × 40,000 sq. ft. × 600 acres × 1,000 ft. fall ÷ 30,000 ft.-lb. × 300 days × 10 hours × 60 minutes = 533 horse-power.

This is the gross horse-power, and from this must be deducted loss in friction of water-pipes, loss in water-wheels, loss in electric generators, and loss in transmission to the place where the power is required. So that we may calculate upon getting actual work equivalent, according to length of transmission and other circumstances, of from 200 to 300 horse-power. If we multiply that by the 3,000 miles of mountains 100 miles wide, we get 150,000,000 horse-power (gross). But the fall of water is more than 1,000 feet. In many places we might utilise a fall of 10,000 feet. And the rainfall is more than 4 feet in many places. In some parts of the Himalayas it is as much as 30 feet in one year. So that there is a practically unlimited amount of power to be got out of the rainfall and snowfall of the Indian mountains.

There is another way in which we can measure the possibilities as regards water-power. Sir W. W. Hunter, in his great work on India, gives the volume of water in three great rivers, the Indus and its tributaries in the Punjab, the Brahmaputra and the Ganges. The lowest summer fall of the Indus and tributaries is 41,000 cubic feet per second. The lowest water-fall in the Brahmaputra he puts at 146,000 cubic feet per second. The Ganges, the lowest volume, he puts at 6,000 cubic feet per second. Taking those cubic feet, and assuming a fall of 1,000 feet, we get 22,500,000 horse-power. But, of course, when the time comes for utilising the power in those rivers, great reservoirs will be built in the mountains, so that the power utilised would not be the lowest summer fall, but might, if required, be five times that amount. Professor Shiv Narayan has published this year (1922) a most instructive book entitled *Hydro-Electric Installations of India.* This Professor is a man with a great many scientific attainments. He is Professor at the College of Engineering, Poona, in India, and has had considerable experience in America. On page 2 of that book Professor Shiv Narayan says: "The rainfall and snowfall over India could provide potential energy equivalent to some thousand million kilowatts." That is equivalent to 1,300,000,000 horse-power. But he does not think it theoretically possible to utilise more than 100,000,000 kilowatts, and he doubts if the practical difficulties which exist will not prevent even a tenth part of that from being utilised. But it is highly

probable that a power of 10,000,000 kilowatts is as much as India may really require to use for a great many years to come. The goldmines of Mysore have been worked for a good many years by water-power from the Cauvery Falls. Professor Shiv Narayan quotes from the *Preliminary Report on Water-Power Resources of India and Burma*, a table (page 251) giving some account of the principal hydraulic works and the hydro-electric installations of India. This gives an account of fifteen of these installations, and according to this table the capacity of the plant installed at the Cauvery Falls is 22,650 electrical horse-power. This is the second largest hydro-electric station in India, the largest being that already mentioned, which supplies Bombay with electric power. On pages 254 and 255 Professor Shiv Narayan quotes again from the same report. According to this the total hydro-electric plant already installed in India is equal to 111,860 electric horse-power, and the writer of the report gives a table showing what he considers will be the probable future water-power of India and Burma, amounting in all to 1,774,000 electrical horse-power. I think myself that the power developed in the future will probably very greatly exceed this amount.

It is impossible to separate the consideration of the hydro-electric power stations of India, and the consideration of irrigation of lands which do not have sufficient rainfall or on which the rainfall is precarious. Some of the Indian Government engineers have prepared designs for the construction

of great reservoirs, the object of which is to provide a great storage of water so as to utilise the heavy rainfall in the Western Ghats for supplying the deficiency of the Eastern plains and valleys. (Some such reservoirs already exist.) These schemes would probably have been begun and some of them completed long ago, but in India it is always a question of finance, and these schemes are waiting until the money is found to put them into execution.

In a paper recently read to the East India Association by Mr. Arthur T. Arnall, Mem. Inst. C.E., A.M.I.E.E., etc., an account is given of the great works completed on the Tata hydro-electric scheme, and also the works in progress and contemplated to complete that scheme, which are as follows: Bhiopuri 65,000 horse-power, Khopoli 50,000 horse-power, Bhira 150,000 horse-power, Ambavli 400,000 horse-power, Kumbharli 250,000 horse-power. These are all on the high Western Ghats in a district where the annual rainfall is from 100 inches up to 250 inches.

These Tata installations are on an entirely new principle—that is to say, new as regards very large installations. They are not founded on the flow of a river running in its usual course, or on the flow of a river coming from a lake which makes a natural reservoir, but on artificial reservoirs on high mountains where there is a very heavy rainfall, from 100 inches up to 250 inches a year, nearly all falling in about three months, so that there is an enormous fall of water during that brief period, and afterwards there

is hardly any rain. It is, therefore, evident that these hydro-electric works depend upon a great storage of water. Therefore Messrs. Tata have made enormous storage reservoirs. That it is possible to make these reservoirs as a profitable outlay of capital is due to the fact that they are on such high ground, so that the fall as in the first completed installation from the outlet of the reservoir to the power station is about 1,725 feet. When the water has done its work at the power generating station, it would then be available for use for irrigating purposes during the dry season. It is evident that these works made and projected by Messrs. Tata are calculated to be of very great benefit to the people of that part of India.

It is to be hoped that before long the Government will put in hand new great storage reservoirs (some have already been made) for irrigation purposes on the eastern side of the Western Ghats, and the water from these storage reservoirs might be used also for the purpose of generating power which would be useful for many purposes on the eastern side.

No doubt the time will come when on the Himalaya Mountains great storage reservoirs will be made for the purposes of generating power. So far as these storage reservoirs have an effect upon the flood waters of the rivers it will be a beneficial effect as limiting the erosive force of the torrent. The water used at the power station will either be turned again into the rivers or conducted in separate canals to places requiring irrigation in the dry season. Storage reservoirs on a smaller scale will doubtless

be started some day in the Eastern Ghats, the Vindhya range and the Maikal range of hills. All these storage reservoirs will have as one of their chief objects the use of the water for irrigation after it has been used for the purpose of developing power.

It must be borne in mind that on the eastern side of the Western Ghats, from there down to the sea, there are large tracts on which as a general rule there is rain enough to raise a crop sufficient to keep the people alive, but every few years there comes a drought or a partial drought, and then the rainfall is not sufficient. Now, the idea of some of the Government engineers who have designed these great storage reservoirs is to keep a great stock of water here ready in case the monsoon shall fail, so that the water may then come down and help to irrigate the crops.

The rulers of India three or four hundred years ago made great reservoirs, or tanks as they were called, and so established their claim to be regarded as friends of the people. The British Government has done a great deal in making both canals and tanks, but it must do still more.

The river Indus has a great tributary coming from the east, the Kabul river. Sir W. W. Hunter has stated that the flood waters of the Kabul river are equal to the flood waters of the Indus, and that shows that great storage reservoirs might with advantage be placed in the high land from which the torrents fall into the Kabul river. Of these tribu-

taries the rivers Swat and Panjkora are entirely, and Chitral river partly, in the North-West Frontier Province.

It is highly probable that when there is rain on the Sulaiman mountains and other mountain ranges east of the Indus and running parallel to it the torrents are not controlled, and it would be a great advantage to the country if great reservoirs were made to cut these torrents near their source. Of course the size of the reservoirs would bear some proportion to the rainfall, which is not great, and therefore the cost would be proportionately small. With this water storage small power stations could be erected as required. Meantime the chief use of the reservoirs would be for irrigation, which would enable the inhabitants to grow crops, but one of the objects would be to help the planting of trees as part of a general plan of afforestation.

The great province of Sind lies beside the river Indus, both east and west of it. It occupies about 34,000;000 acres. The native State of Khaipur, adjoining, is another 4,000,000 acres. Out of the 34,000,000 acres of British-governed territory more than 14,000,000 acres are said to be not available for cultivation (being a dried-up desert), about 6,000,000 are said to be culturable waste, another 5,000,000 to 6,000,000 are "current fallows," the net area cropped is about 3,000,000 to 4,000,000 acres, and when there is an unusually large rainfall it amounts to about 4,500,000. Of the area cropped nearly all is irrigated, chiefly by Government canals. The

rainfall is very small, from 5 to 10 inches over the greater part, but there is a considerable area where the rainfall is under 5 inches.

Very little use is now made of the enormous volume of water in the Indus, a volume far exceeding that of the Ganges. Money laid out on the irrigation of the province of Sind would be an exceedingly profitable investment for the people of India. It is necessary for the Government to give its attention to these practical matters of vital importance to the well-being of the people, but it continually delays, and such delay is ruinous and wrong. The money which has been wasted on fantastic campaigns in Afghanistan and the North-Western Provinces would have made a fertile and rich province of Sind, and forests would now be growing on the bare mountains. It is about eighty years since the East India Company first made its great war on Afghanistan, from which the British troops were ultimately driven back. It is about forty-four years since the second Afghan war was made, from which also our troops wisely retreated after carrying fire and sword into the homes, and destroying the orchards of the poor people of Afghanistan who had never done us any harm. This second war cost a hundred million pounds (£100,000,000).

The great and beneficial works which their professional advisers recommend should not be held up because the Indian Government prefers to spend money on military armaments. The conditions are not the same as they were sixty years ago from

a military point of view. Then there were almost no railways, now there are railways all over India, so that troops from all parts can rapidly converge on any district where they are required. Then there was a three months' voyage round the Cape, now in a month's time munitions and re-enforcements can come from England through the Suez Canal. Also the change in the armaments makes it impossible for people who have not got control of arsenals where the most modern weapons are stored to fight against the Government troops. Then the ordinary blacksmiths could make guns, bayonets, spears and swords, the ordinary iron-founder and brass-founder could make first-rate cannon, bullets, cannon-balls and shells, and the manufacture of gunpowder was easy and common. Now special tools, special steels, special chemicals are required for a tolerable armament, and no frontier tribes, rebels or mutineers could get these. Then cavalry was the most rapid means of moving troops; now aeroplanes that move at a speed of more than 100 miles an hour can drop deadly bombs on a rebel force that cannot possibly possess similar weapons. So that 50,000 soldiers to-day are at least as effective as 200,000 sixty years ago.

CHAPTER XVI

The Irrigation problem—Drainage—Drainage essential to successful irrigation—Lands poisoned by salt brought to surface by capillary action unless subsoil water-level kept down—Mr. John Ashford's tube well pumps water without sand—An invention of very great importance—Government very slow in proceeding to use it—Hydro-electric stations generally useful for irrigation wells, also for the manufacture of nitrolin for manure.

THE inexperienced water engineer and the inexperienced agriculturalist who sees a fertile soil which is incapable of yielding any crops because there is no water, thinks that if only water was applied in sufficient quantities the result would be to make very fertile and wealthy districts, but experience shows that it is not enough to bring the water there, that the irrigation canal is only part of the work. The other part of the work is a drainage canal or a drainage pump. An example of this can be found in North Italy in the provinces of Lombardy and Venetia, where there is one of the most wonderful systems of irrigation in the world. It has been working for many centuries. The rains and melted snows come down from the Alps into the rivers and then are guided in irrigation canals into the fields, and from the fields the water flows away into great

drainage canals, so that the fields do not get water-logged, the ground is not turned into a swamp. Wherever this drainage is not properly carried out, the ground gets eventually water-logged and seriously injured.

Practically all river water contains some salts of various kinds. These salts get into the river water, because the rain on the hills and mountains, the little streams, the swamps, pools and lakes dissolve these salts out of the soil, sands and rocks. The river carries the salt down to the sea, and every year the sea gets more salt.

In large districts of the Ganges plains where irrigation canals have been introduced and freely used, the ground has been poisoned because the system of drainage has been defective. A great deal of the irrigation waters sink down into the ground, and gradually the subsoil water-level rises until it gets within, say, 3 feet of the surface. Then in the summer time the water rises by capillary channels up to the surface, and there is evaporated by the great heat of the sun. The mineral contents of the water are left on the top of the ground. Therefore, if this capillary attraction goes on year after year, and the water is evaporated and the minerals deposited, there gradually gets so much salt on the surface that the ground becomes incapable of giving good crops.

In other cases, as a result of free irrigation, the ground becomes actually swampy, and in India swamps are the cause of malaria, because the mosquito

breeds there and carries malaria from man to man and from house to house. This has happened near the town of Amritsar in the Punjab. A great irrigation canal passes within three miles of that city. The canal is not water-tight, and water escapes through the bottom and sides. This water escape, and also the copious use of the water for irrigation, has raised the water-level of the country around. Before the canal was made this sub-soil water-level was 60 feet below the surface, that is to say it would have been necessary to dig a well 60 feet in order to get a supply of water. Now the water-level has risen to within 2 or 3 feet of the surface, and in the rainy season the land becomes a swamp. Mosquitoes breed in these swamps and poison the people of Amritsar, and the number of deaths from malaria has been considerable, occasionally very serious indeed. The evil is known, the people die, but the Government is very very slow in trying to make a remedy, and yet the remedy is also known and could be put into practice without delay. This was described by Mr. Stephen Leggett, Mem. Inst. C.E., in a paper he read at the Institution of Civil Engineers on March 8, 1921.

On the vast plains of India the drainage problem is not always a very simple one, and to make drainage canals is not always easy, even if it is possible. Some engineers have tried to lower the water-level in the subsoil by means of wells and pumps. But pumping is a very expensive operation if it is done by human labour or by means of oxen. It only becomes practi-

cable at a reasonable price when mechanical power of some kind is used. It may be practicable with oil-engines, and indeed in some parts of India those engines are used for the purpose of irrigation wells

It is not always practicable to make a well from which water can be pumped, because the subsoil may be quick-sand, so that when you try to pump the water, you pump the sand also, and the sand clogs the pump, and if it didn't, there would be no place in which to put the sand when it had been pumped up. Therefore the problem was, how to make a well from which the water in large quantities could be pumped without pumping the sand. Wells were sunk lined with brickwork, the bricks being effectual in keeping out the sand. They were also effectual in preventing the sufficiently rapid inflow of water. Wells consisting of perforated iron tubes were put down, but these if they admitted the water sufficiently fast also admitted the sand. The credit of an invention of a tube well from which water in great volume could be pumped without sand belongs to Major John Ashford, M.I.Mech.E., O.B.E., mechanical engineer in charge of the machine-works at Amritsar. He invented a tube which would be strong enough to resist the pressure of sand and water at a great depth and yet should allow the water to run in. It was not possible to drill holes in the tube small enough to exclude the sand and which would let the water through in sufficient quantities, but Mr. John Ashford hit on a plan of making an exceedingly long spiral slit, so narrow that the sand could not

get through. The pipe was made of long straight iron bars laid round a ring inside. These iron bars were placed an inch or more apart. Round the iron bars on the outside was wound a copper wire of trapezoidal section. The wire was wound under tension, the distance between each spiral ring of the wire and the one previously laid being from one-eightieth to one-hundredth of an inch according to the class of sand met with. These "pipe-strainers" are made 10 inches diameter in convenient lengths joined together so that they would reach to a depth of about 155 feet; 120 feet of this pipe-strainer, with a water slit, say, 2,000 feet in length, will permit the passage of 2 cubic feet of water per second with a head of 14 feet of water outside (a 7-foot head gives 1 cubic foot, a 21-foot head 3 cubic feet per second). Two cubic feet a second is equal to 750 gallons of water a minute. A brick well is sunk 22 feet, and a turbine or centrifugal pump is placed in the top of the tube near the bottom of the brick-walled well. Sixteen of these wells have been sunk, but enough has not yet been done to materially affect the sub-soil water-level in the Amritsar district, but as the work is extended no doubt the desired effect will be produced.[1] The pumps are worked by electric

[1] Major John Ashford, writing from Amritsar on the 17th May, 1922, says the subsoil water level is now about 10 feet lower than in some previous years, partly he thinks due to a poor monsoon in 1920 and poor winter rains, but partly due to his pumps, which he estimates have effected a lowering of the water level of about 5 feet.

He says his pumps are now largely used in many parts for raising water (from sandy ground) for water supply for irrigation and for general purposes.

motors, and the current is derived from hydro-electric generators.

The gradient of the canal is too steep for it to be permissible to let the water run straight along at that gradient, therefore dams are put in at suitable distances and the canal is stepped down in steps of varying height from 4 feet to 9 feet. At these dams it is possible to put a hydro-electric station to take the power of the water falling 5 feet or 9 feet as the case may be. The power gained from this hydro-electric station is conveyed by overhead wires carried on suitable steel towers to a distance to work other pumps, or for other purposes. The water that is thus pumped up is available for irrigation purposes, and is sold for that purpose, so that the cost of the pumping is not an expense, because the cultivators will pay more than the cost of pumping for the water that is delivered to them. So this system of hydro-electric power pumping will have a great beneficial effect when it is carried out on a sufficient scale. It will drain the water-logged areas of the Punjab, and so greatly improve the health of the population, which suffers enormously from malaria, caused by the water-logging of the ground, caused by the irrigation canals which the Government put up without considering sufficiently the question of subsoil drainage. Possibly the engineers thought that they might make the canal watertight, and that could be done if sufficient money was spent. The difficulty to-day is this, that a large population depends upon this canal for its water in order to

raise crops in a district where the rainfall is too scanty, therefore it is impossible to stop the canal in order to make the necessary alterations to make it watertight, and to construct a parallel watertight canal would be very expensive. Therefore the more economical and practical scheme is the system of pumping. It is now eleven years since Mr. John Ashford invented this plan. Ten years had passed when Mr. Leggett read his paper in 1921. In that ten years the work done has been fifteen little wells and one small hydro-electric station. If the Government had cared to give attention to practical matters there would have been by this time not less than 1,500 wells, perhaps thousands of these tube wells. The malaria would have been reduced, very possibly it would have been abolished from this district, but the money that would do all this has been spent in threatening the Ameer of Afghanistan with a war. Fortunately the Indian Government had wisdom enough not to carry this threat into effect, but the preparations for this war, from which no possible advantage could accrue to any human being in the world, cost more than all the hydro-electric pumping stations required for the country fed by this irrigation canal.

Wherever electric power is available it might be made use of for pumping water from wells for irrigation purposes. There are large areas of India now a barren desert because the river floods have scooped out the bottom of their channels and so lowered the level of the rivers that the ground is now 50 or

110 feet above the river water-level. This is too great a depth from which to raise water by means of oxen-driven well pumps for irrigation purposes, but where electric horse-power is available, then water for irrigation might be raised from these great depths, and that would make cultivation possible and also afforestation possible in those districts.

Wherever there are great hydro-electric powers that are not fully used with urgent work, they might be employed in extracting nitrogen from the air for the purpose of making nitrolin or (with sulphuric acid) sulphate of ammonia, or some other compound of nitrogen which would be suitable for manures and render it unnecessary to buy nitrate of soda from Chili. And no doubt this nitrolin could be made at a very small price, providing it was not charged with interest on the cost of the hydro-electric installation. If that plant worked in the day-time in driving mills or other works that are chiefly daylight work, then at night it might be used for the manufacture of nitrogen compounds, which would help to make the soil productive, and thus make these great hydro-electric works profitable. These nitrogen compounds will keep in a warehouse for a long time if required. Therefore they might be manufactured in the flood season when there was plenty of water-power; but the erection of hydro-electric generators for the flood season only would be an additional expense that would require an additional outlay of capital for that special purpose, and therefore that capital

outlay would have to be charged against the production of nitrolin. There are other chemical compounds that can be made where there is a sufficient supply of cheap hydro-electric power, and indeed iron-works can be worked by that means; but in the first place the hydro-electric power should be used for those productions which are necessary to increase the fertility of the soil and so make the lives of the poorer portion of the people of India more tolerable.

CHAPTER XVII

Coal and iron ore—Electric fans and motor cars help to make the heat more tolerable.

INDIA possesses great stores of minerals, amongst others coal of sufficiently good quality both for household purposes, steam-raising and iron-smelting. The output of coal has now reached over 20,000,000 tons a year, and it could no doubt soon be developed to twice that quantity if there was a demand for it. There are enormous stores of first-class iron-stone, and great iron and steel works have been built in Bengal, and no doubt these will be further developed and help to supply the great wants of the country.

If the supplies of food produced by the soil should increase, there is sure to follow a great demand for the production of ironworks, as well as other mineral and metal productions. There are very valuable petroleum wells in Burma. It is sad to think of the people of India burning cowdung for fuel for cooking purposes when they might easily have petroleum cooking-stoves, but, of course, the cost of the stoves is quite out of the reach of the poor people, and then the cost of the petroleum is quite

beyond them. It is curious at every turn to find oneself up against this problem, that here we have got a nation the very poorest that is possible. They have no clothes to spare, no food to spare, no valuable stores to spare, and so the development of the great resources of the country is held up and is hindered, and yet the means of wealth are at hand. Some people would say that nothing could make India a tolerable country on account of the great heat, but Englishmen have made a great discovery, they have found that an electric fan in their rooms makes the temperature quite comfortable as a general rule, or at any rate it makes a great difference. They have also found that a motor car makes it possible to ride about at the hottest time of the day without discomfort. If between 11.30 in the morning and 3.30 in the afternoon you are driving along in a carriage drawn by a horse the heat of the sun will seem intolerable. If you are in a rapid-going motor car, the current of air makes quite a difference, and I have been told that these two modern inventions have produced a great effect upon the way in which an Englishman looks on life in India ; and there is little doubt that when the reforms which I have indicated are carried out, not only Europeans; not only wealthy Indian gentlemen, but all the people of India will live on a higher level of comfort than is now the case.

CHAPTER XVIII

Government not to blame for everything that is wrong—For instance, the early marriages, the borrowing of money which cannot be repaid, poor men selling themselves into slavery—Agricultural banks—Local committees to regulate loans and rate of interest—People must reform their fashions and energise their own advancement.

Of course, it is quite proper to abuse the Government for everything that goes wrong in India, the same as in every other country, and there is no doubt all the Governments of the world amply deserve all the abuse they get. But for all that, it is not fair to say that the Government alone is to blame when things go wrong. When a nation has the absurd custom of marrying little children so that a woman of twenty-eight may be a grandmother, and at forty-two a great grandmother, and at fifty-six a great-great-grandmother, how can the nation hope for wealth and prosperity? The continuous following on of more children and more children gives them no chance to make a bargain, they have to take anything that is offered them. If they are landowners, they have to keep dividing up the proceeds of their property between more and more children. If they are small cultivators, they have to keep

dividing up their holding to find places for their children. If they have no land, and are not tenants of any land, they have to take any offer of the landowner or money-lender and become his slave. It is absurd to blame the Government for that. One of the paradoxes of life is that in most societies the people who can least afford to pay taxes are those who are most heavily taxed. The tax takes the form of a payment of interest on money that has been borrowed, and this money has been borrowed by poor people who cannot afford to repay, and are really too poor to pay interest on the loan without starving themselves. In some parts of India a young man, little more than a child, will borrow money to pay for his wedding feast, well knowing that he will never be able to repay the money he has borrowed or the interest on it, and will become a slave of the money-lender. That is an extreme case, which, however, is quite common in the Madras Presidency. This is described by Professor Gilbert Slater of the Madras University in his book entitled *Economic Studies*, vol. i.—"Some South Indian Villages." But over all India the money-lender is a most important personage. He may lend money, and does lend money for purposes which may yield a good return to the borrower. On the other hand, he may lend money for the purpose of a wedding feast or a dowry to a daughter, or the purpose of meeting a revenue tax, and he charges a high rate of interest, which in a great many cases leads to the ruin of the borrower. I do not know that

the lender is to blame. I do not know that he makes more than a fair profit on his outlays, but what I know is that the system is an unhappy one.

An effort is being made in many districts to establish local banks, and in connection with these local banks to establish local committees. In India, government of the village life by local committees is quite the rule, and it is a form of self-government that the people well understand, and it is very old-fashioned. In some districts it has now come about that the local committee has power to lend money to members of their village or district for reasonable purposes, and to lend the money at a moderate rate of interest, so that the payment of the interest and repayment of the loan may be possible. It is the object of those who manage these committees to make the loans as small as possible. The loan, of course, may be for the purpose of buying an ox or a cow or some necessary implement, and in that case the loan must be sufficient for the purpose. But the loan may be for some social purpose, such as the marriage of a son or daughter, and then the object of the Committee is to make the loan as small as possible, to tell the borrower that what he is proposing is extravagant, and if he asks for 100 rupees, to induce him to be quite content with 20 or 30. I do not know if these local committees say anything about the age at which a child should be married, but I should think it quite possible, if the time has not already come,

that the time will soon come when these local committees might suggest to the would-be borrower that he might put off the occasion for a year or two years, and so gradually raise the age at which marriage takes place. I understand that the Brahmo Somaj advocates later marriages, also that the Parsees marry at a later age. There is no doubt that religious teachers have great influence. They may teach early marriages or they may teach marriages at a later age, but if they teach the latter it is probable they will confer a great blessing on the people, because although India might hold and feed a population twice the size of its present population, the population should not continue to try to increase at the rate at which it has tried to increase in the last fifty years. It is quite likely that with the increase of production that would follow the means I have suggested and the consequent increase in comfort, the people may appreciate the advantage of enjoying a higher material standard of life than has been possible for most of them hitherto. When they have tasted some of the pleasures that money can buy, they may begin to consider how they can modify their present fashions so that they can get more fun out of life.

In the early part of the year 1922 an English nobleman of great experience as the Governor of a great Indian Presidency, speaking of the cultivators of the soil in India, said, "They do not live, they only exist."

India ought not to be a country where the most

important and most useful part of the population is a subject for pity or contempt.

So I venture to say to the people of India :—

"BLAME THE GOVERNMENT BY ALL MEANS, BUT BLAME YOURSELVES AS WELL; EXERCISE YOUR GREAT INTELLECTUAL FACULTIES TO WORK OUT YOUR OWN ADVANCEMENT, AND YOU WILL GAIN NOT ONLY MATERIAL WEALTH, BUT INTELLECTUAL JOY, AND THE RESPECT OF ALL THE OTHER PEOPLES OF THE EARTH."

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